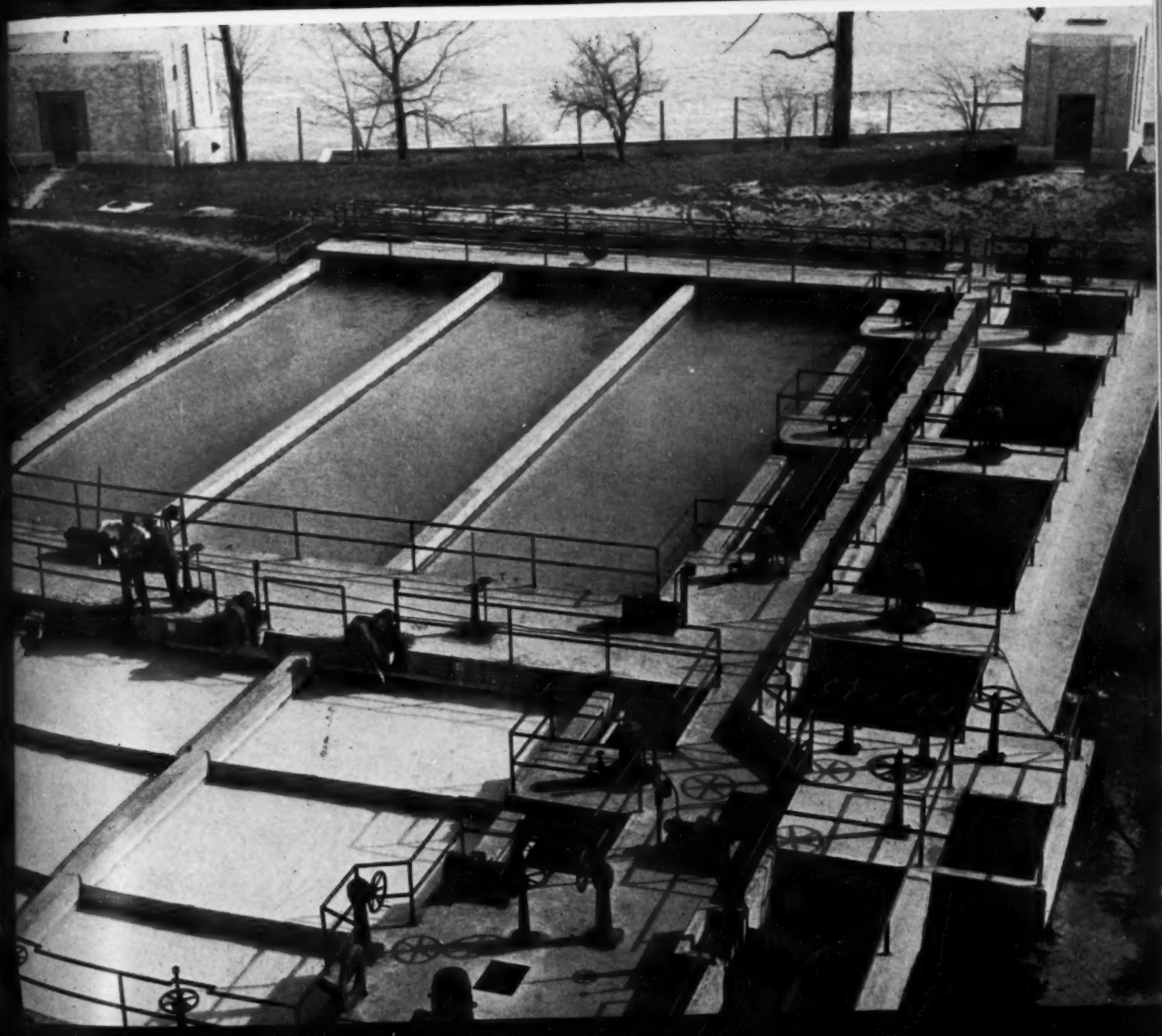
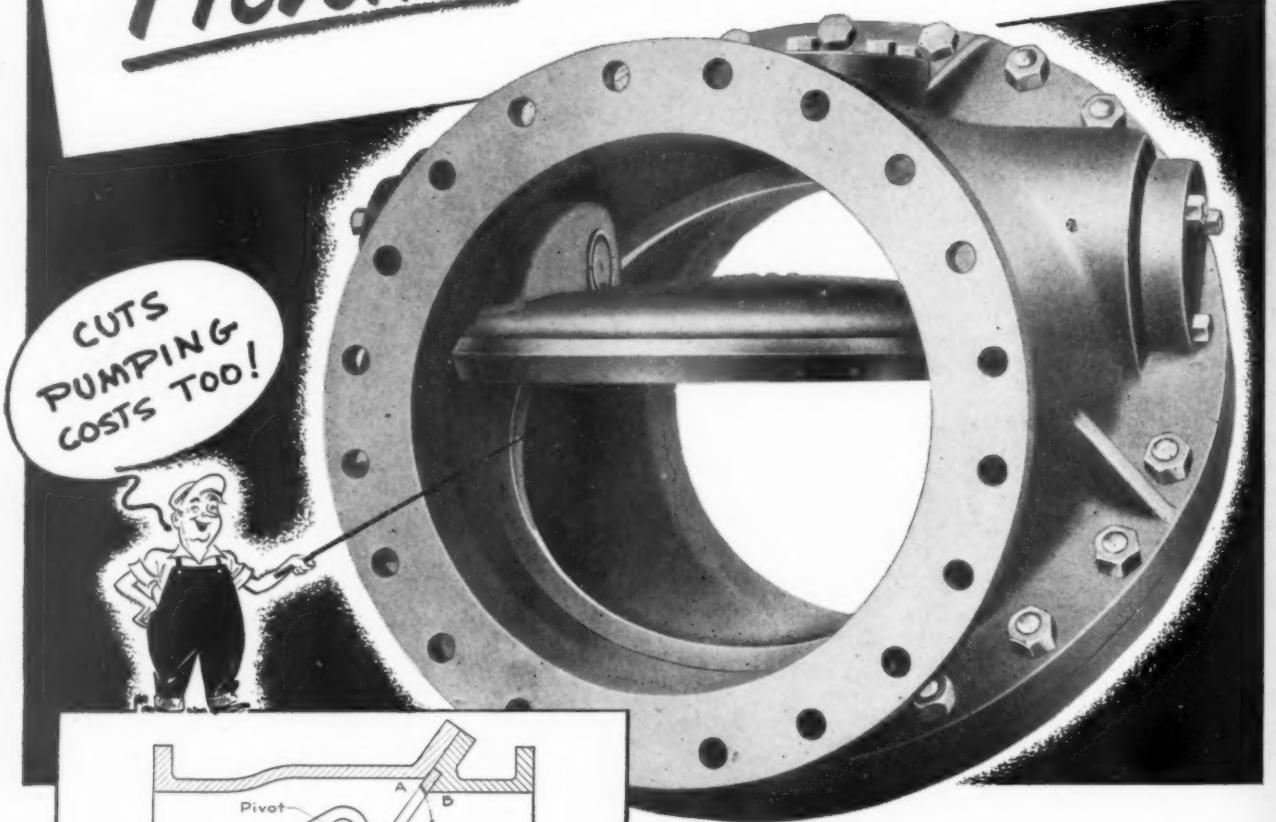
WATER & SEWAGE WORKS

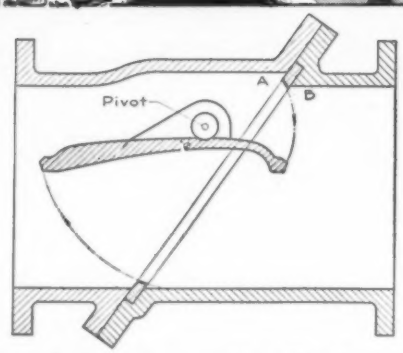


THE "CUSHIONED CLOSING" OF

CHAPMAN (TILTING DISC) CHECK VALVES

Prevents Water Hammer





Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The smooth performance of a balanced hinge-pinned disc gives Chapman Tilting Disc Check Valves a quiet, "cushioned closing." There's no slamming, as in ordinary check valves, and therefore no destructive pipe-line stresses. This means that water hammer and its resultant vibrations and strains in pipe lines are eliminated.

This unique check valve not only reduces maintenance costs but effects savings of from 65% to 80% in head losses over conventional type check valves. And Chapman Check Valves are available in either iron or steel.

Send for bulletin containing complete information.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASS.

WATER AND SEWAGE WORKS, "Reg. U. S. Pat. Off.," September, 1947. Volume 94. Number 9. Published monthly by Gillette Publishing Co., 22 W. Maple St., Chicago 10, Ill. Per Copy, 25c. Subscription rate: United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as Second Class Matter, March 12, 1946, at the Post Office at Chicago Ill., under act of March 3, 1879.

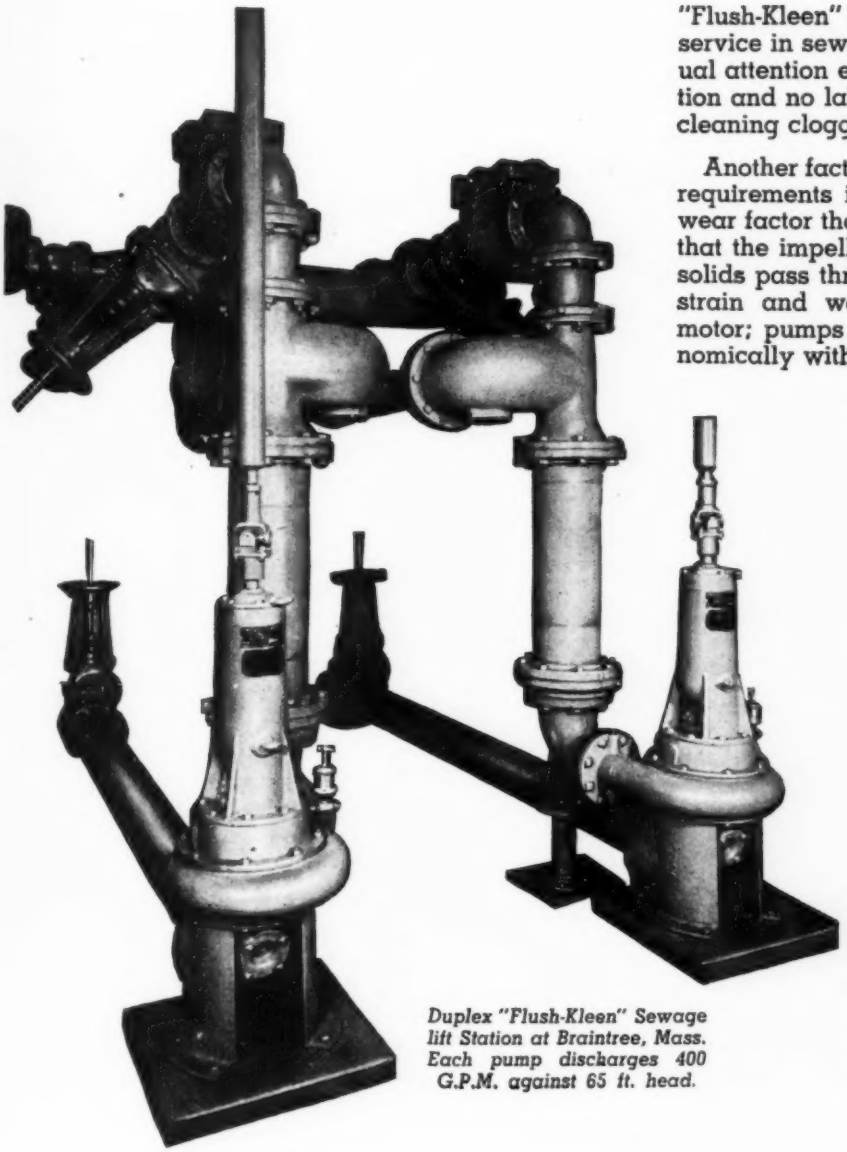
When Trouble-Free, Low-Maintenance, Clog-Proof Pumping of Sewage is Needed, Flush-Kleens are Specified

Because-

They Cannot Clog as Solids Do Not Pass the Impeller

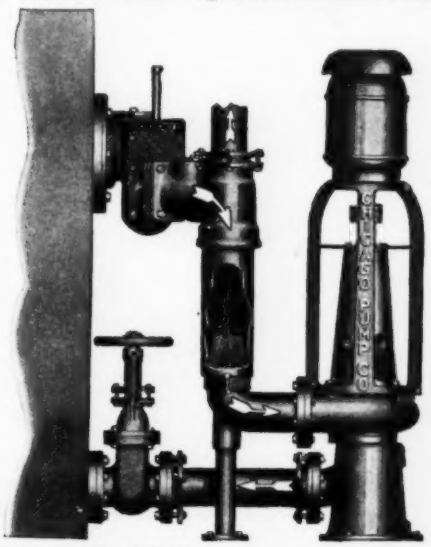
"Flush-Kleen" pumps provide automatic, trouble-free service in sewage lift-stations. They require no manual attention except periodic lubrication and inspection and no labor is required for disassembling and cleaning clogged pumps as with other types.

Another factor which greatly reduces maintenance requirements is that "Flush-Kleens" have less of a wear factor than other pumps. This is due to the fact that the impellers handle only strained sewage. No solids pass through the impeller to cause excessive strain and wear on impeller, shaft, bearings or motor; pumps remain in balance and operate economically with little attention.



Duplex "Flush-Kleen" Sewage lift Station at Braintree, Mass. Each pump discharges 400 G.P.M. against 65 ft. head.

"Flush-Kleens" operate alternately



Filling Wet Well

- Sewage flows through inlet pipe.
- Coarse matter is retained on strainer.
- Strained sewage flows through idle pump to wet well.

Pumping

- Strained sewage is pumped from wet well.
- Coarse matter is backwashed from strainer.
- Special check valve closes; sewage and coarse matter are pumped to sewers.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

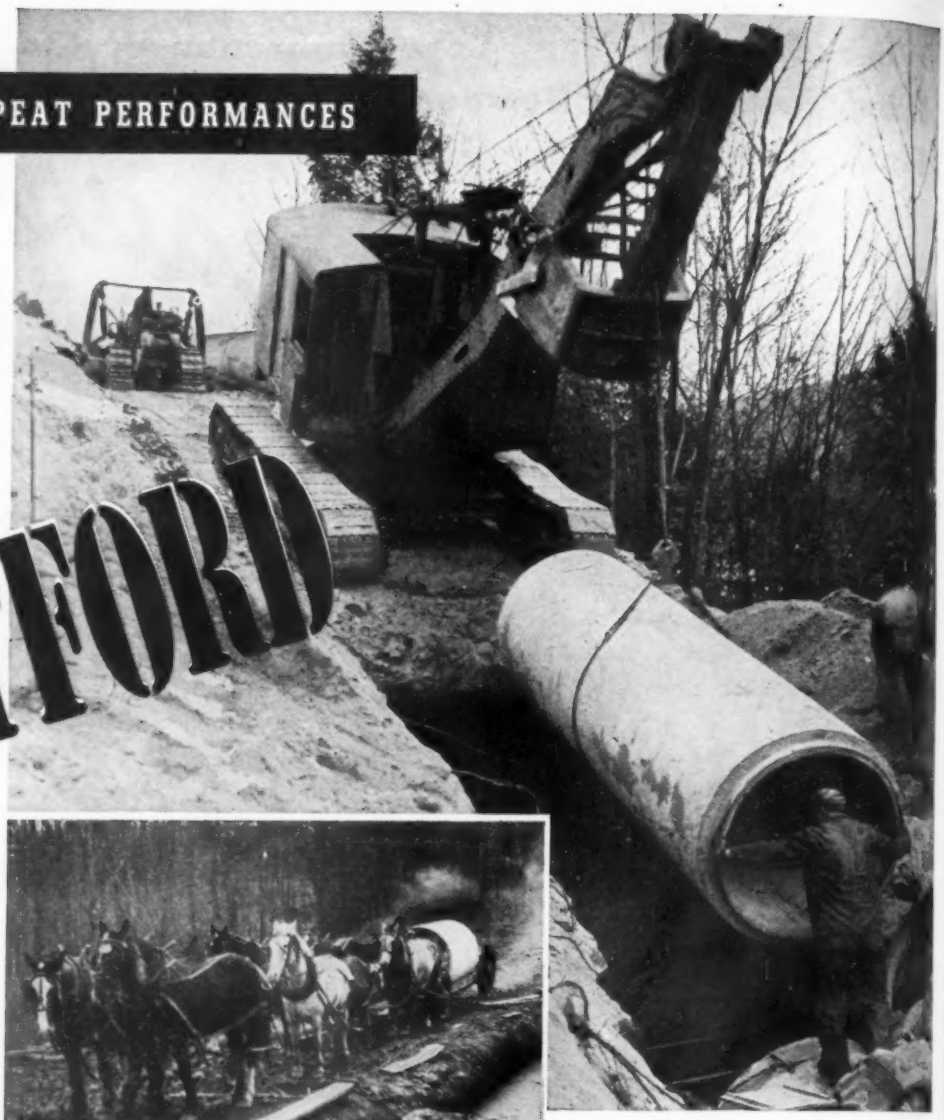
2349 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**

Flush-Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

LOCK JOINT REPEAT PERFORMANCES

HARTFORD



9 JOBS SINCE 1918

1940 – Above: Modern installation of 48" concrete cylinder pipe.

1918 – Left: Delivery of 48" pipe by six horse team.

For almost 30 years the increasing demand upon the water supply system of Hartford has been met with Lock Joint pressure pipe lines. Since 1918 nine separate contracts for supplementing the City's existing water supply system have been awarded to Lock Joint Pipe Company. By specifying Lock Joint Reinforced Concrete Pressure Pipe, Hartford, the insurance capital, has assured itself of water supply lines of unfailing service whose estimated life expectancy is better than 100 years!

Repeat orders from Hartford and many other progressive American cities are convincing evidence of the permanent high quality and complete reliability of Lock Joint Reinforced Concrete Pressure Pipe.

★

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

Pressure Pipe Plant: Wharton, N. J. • Sewer Plant: Kenilworth, N. J.

BRANCH OFFICES: Denver, Colo. • Chicago, Ill. Kansas City, Mo. • Rock Island, Ill. • Joplin, Mo. Valley Park, Mo. • Cleveland, Ohio • Hartford, Conn. Navarre, Ohio

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

For future projects, large or small, specify Lock Joint Pipe.

A Hazen-Williams Hydraulic Slide Rule will gladly be sent upon request with our compliments.

WATER & SEWAGE WORKS

E. S. GILLETTE, Publisher
22 W. Maple St., Chicago 10, Ill.

L. H. ENSLOW, Editor
155 East 44th Street, New York 17, N. Y.

COMING!

The Forbidding of Strikes by Public Employees

Is a discussion of the significance of recent legislation which forbids strikes by public employees, in which the author gives the employer's viewpoint and offers certain remedial measures to which public management should give great consideration in the interest of the employee who now stands deprived by law of the right of fellow citizens in the matter of labor management relationships. This important article constituted an address of the then retiring president of the Am. Water Works Assn.—

WENDELL R. LADUE, Chief Engr. & Supt.,
Bureau of Water & Sewerage, Akron, Ohio.

Transite Pipe Performance Record

Is revealed in a report from Winnipeg, Canada, covering an asbestos-cement water main after 14 years of service under corrosive conditions. Presented and discussed are the recently conducted field and laboratory tests made for the purpose of comparing the flow capacity, friction losses, strength, and other physical characteristics of the pipe after 14 years of service, with those of the pipe as originally laid. This interesting report comes from—

WM. D. HURST, City Engineer,
Winnipeg, Canada.

Are Your Customers Water Conscious?

Is the question raised and discussed by the small town water superintendent interested in good relations with the public and in particular with the water department's customers. He gives some experiences and well chosen pointers which should be helpful to the small town water superintendent. The author is—

ERNEST J. BEAR,
Supt. of Water & Sewerage, Livingston, N. J.

Sizing Sanitary Sewers

Is an article which presents a novel method of designing (sizing) sanitary sewer systems with the aid of graphic diagrams developed by—

JOHN G. MONTGOMERY, Sanitary Engr.,
Veterans' Administration, Washington, D. C.

The Determination of Zinc

Is the contribution of a chemist who offers an improved method for the determinations of zinc in water, sewage or trade-wastes. The author is—

B. I. CORSON, Instructor,
Camden Co. Vocational School, Merchantville, N. J.

Pipe Line Capacity— Its Preservation or Restoration

Constitutes a brief review of the causes of loss of delivery capacity of pipe lines with increasing age, and the high cost of such depreciation. Then follows a description of known and tested remedial measures for the correction or elimination of such losses, including measures for the restoration of capacity of existing pipe lines, reduction in pumping costs, etc. Contributed but a short time before his recent passing, the author is the late—

WM. S. LEA, Consulting Engineer,
Montreal, Canada.

Some Practical Aspects of Coagulation and Chlorination

Hardly needs any further description than the title. The article relates the experiences of the authors in securing improved and consistent coagulation aided by economy producing pre-chlorination. These experiences are those of—

H. T. HOTCHKISS, Consultant,
and V. A. MASCIA, Asst. Supt.,
Westchester Joint Water Works, Mamaroneck, N. Y.

VOL. 94, NO. 9 — SEPTEMBER, 1947

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WATER AND SEWAGE WORKS is a monthly publication. Single Copies, 25c; Subscription Rates, U. S. and Canada, $2 per year; Foreign, $3.

COLD FACTS ABOUT THE

ONE book of facts can be worth more than a library of books based on conjecture.

Such a book* of facts has recently been published by the American Water Works Association. It records the findings of a study of "Survival and Retirement Experience With Water Works Facilities" in 25 cities.

With the permission of the A.W.W.A., we have reprinted, in brochure form, the facts as they apply to cast iron pipe. This brochure is available on request. Write to the Cast Iron Pipe Research Association, Peoples Gas Bldg., Chicago 3, Illinois, and ask for a copy of "Survival and Retirement Experience With Cast Iron Water Mains."

A feature of this brochure is a chart showing the percentage of cast iron water mains that have survived out of all such mains laid by these 25 cities from the first, some as early as 1817. For example, in sizes 6-inch and over, *more than 90 per cent of all the cast iron pipe that has ever been laid in these cities is still in service.*

Tabulations showing in detail the survival and retirement experience with cast iron water mains, in various sizes, are given for each city; also experience with cement-lined cast iron pipe in the 16 cities that have installed it.

*Available from American Water Works Association, 500 Fifth Ave., New York.

CAST IRON PIPE

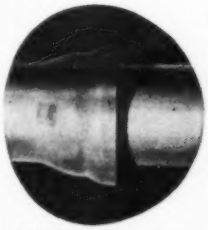
LIFE OF WATER MAINS

The 25 cities were carefully selected to comprise a representative cross-section of conditions; the study was concerned solely with discovering and reporting the facts.

For your convenience and quick reference, we have reprinted such facts as apply to cast iron pipe only—facts which leave no room for conjecture if what you want is water mains with assured long life and efficient life.

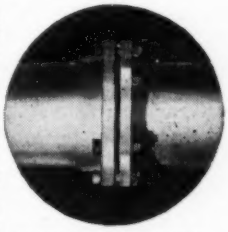
"Cast iron pipe not only offers a century or more of efficient life as a structure—it offers a century or more of efficient life as a carrier. In the limited areas with tuberculating waters, cement-lined cast iron pipe is tuberculation-proof and insures high carrying capacity for the life of the pipe. In the greatly predominating areas without tuberculating waters, the carrying capacity of unlined cast iron pipe remains practically unimpaired for the life of the pipe."

Joints for Cast Iron Pipe



Bell-and-Spigot Joint: the standard joint for water and sewerage service.

A variety of joints are available, of which the two most widely used are illustrated. Special purpose joints, such as the Ball-and-Socket, or Flexible Joint for underwater use, and the Flanged Joint for above-ground use, are also available.



Mechanical Joint: bottle-tight and flexible, now with interchangeable parts.

"SILENT SERVICE is not enough"—A.W.W.A.

The American Water Works Association is recommending to its members, for local action, a sound, well-planned program of Public Relations publicity and advertising. It is based on the premise that good water service, like good health, is too often taken for granted, in which case favorable public opinion is dormant.

To co-operate with this program and help to arouse national recognition of the efficient service rendered by America's water supply systems, the Cast Iron Pipe Research Association is presenting little known facts about public water supply to the *six million* readers of "Time" and "Nation's Business" throughout 1947.

For example, the following human-interest cartoon and excerpts from a current advertisement

"extra!—*read all about it*"

All this excitement about water? Well, if you lived in one of the 5700 towns* that need a water supply system, or any town that needs improvement to its water supply system, you'd understand. An abundant supply of potable water makes life easier, safeguards health and property, attracts industry, rarely increases taxes. The cost of installing or improving a municipal water supply system is usually financed by a bond issue to be liquidated out of revenue from a low delivered cost to the consumer—a cost that averages less than a dime for a ton of safe and palatable water.

Because of the efficient and economical operation of America's water supply systems, water works construction or improvement bonds are rated among the most stable of investments, and have a ready market at a low rate of interest.

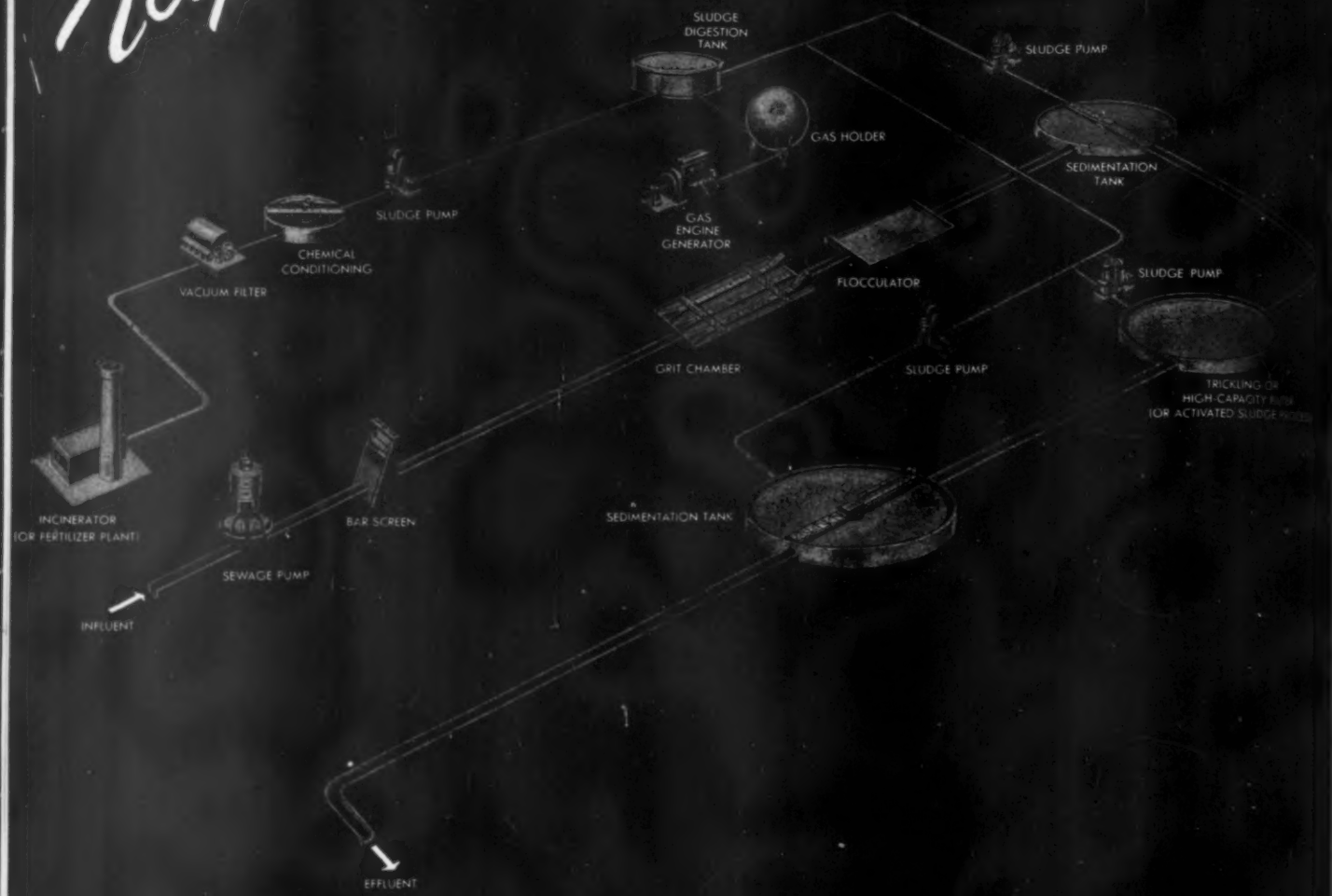
*U. S. Public Health Survey, released July 6, 1947

Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, Peoples Gas Bldg., Chicago 3, Illinois.

SERVES FOR CENTURIES

Unit Responsibility

KEY TO MORE O



. . . FROM INFLUENT TO EFFLUENT . . . IN PLANTS OF ANY SIZE

Regardless of the size or capacity of your plant, you can rely on Westinghouse for help in stepping up system efficiency. For Westinghouse produces dependable, installation-proved electrical equipment for co-ordinated drive and control of every process from influent to treated effluent.

Whether the drive requires ¼ hp or 5,000—50 motors or 500—Westinghouse can help you select and apply the right motor drive and control or any allied electrical equipment needed to improve your methods. Because Westinghouse can supply *all* of your electrical requirements, the expense and annoyance of piecemeal ordering are eliminated.

So today, as you plan modernization or extension of facilities, look to Westinghouse for the best in drive and control equipment regardless of the extent or nature of your needs. One supplier . . . one responsibility . . . one desired result: more efficient operation of every process from influent to effluent. Make Westinghouse your electrical partner at the planning board. For details call your Westinghouse office or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-94747

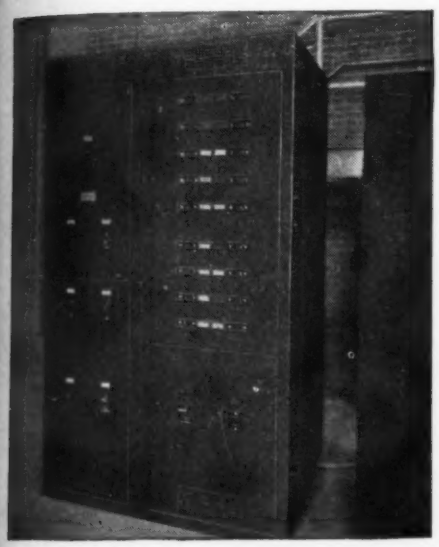
E OPERATING EFFICIENCY

"WESTINGHOUSE-EQUIPPED THROUGHOUT" MEANS SIMPLIFIED ORDERING, QUICKER INSTALLATION, MORE EFFICIENT OPERATION

Putting power to work *productively* can be a major problem—or a simple one. When items must be selected, ordered and received from many sources, it means many chances for costly errors and delays . . . divided responsibility—or none at all—for performance of installed equipment.

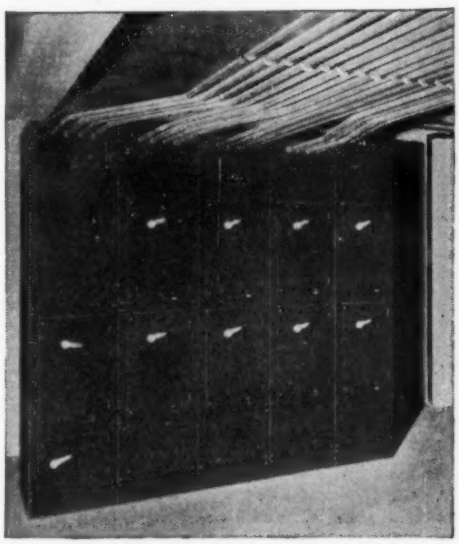
Westinghouse offers the way to simplify the job. From equipment for generation of electrical or steam power, to the most specialized types of drives and control for its utilization, Westinghouse provides a single source of supply . . . one broad pair of shoulders competent to take responsibility for performance of all parts of the job.

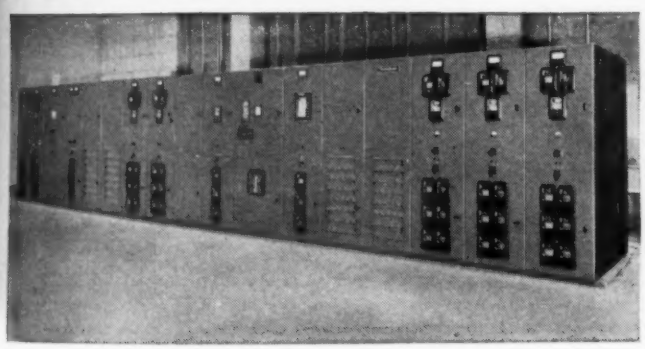
Here are a few of the places where Westinghouse unit responsibility prevents headaches . . . saves money . . . assures *more productive* power:



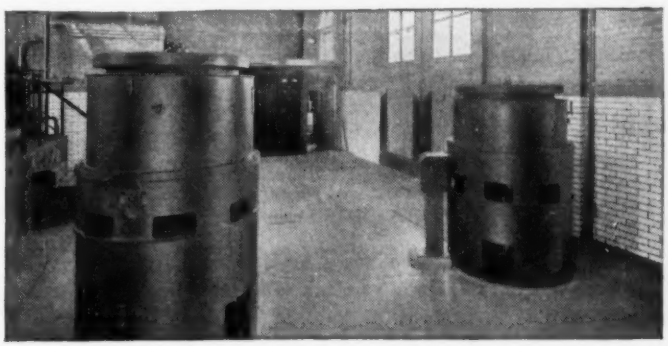
PANELBOARDS—Westinghouse control panelboard installed in a 9,000 gpm plant, including main incoming breaker, motor feeder breakers, lighting and auxiliary circuits; all in one attractive, easily installed unit.

CONTROL CENTERS—Typical Westinghouse Control Center which houses control for auxiliary motors at one centralized location—improves operating safety, simplifies operation and maintenance. Additional units can be added as needed.





SWITCHGEAR—Westinghouse Indoor Metal-clad Switchgear (2,300 volts) for feeder circuits to main pump motors. Factory assembled and tested to assure proper protection of vital equipment. Installed as a unit.



MOTORS—One 350/160 and one 250/100 hp two-speed Westinghouse CS Motors driving main sewage disposal pumps. (Metal-clad control panel in background.) These motors use low speed and low hp for normal sewage flow. High speed and high hp increase pumping capacity 300 percent for handling emergency conditions.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

MORE PRODUCTIVE POWER FOR INDUSTRY

For economical, efficient removal of screenings...

from 0.5 to 150 MGD

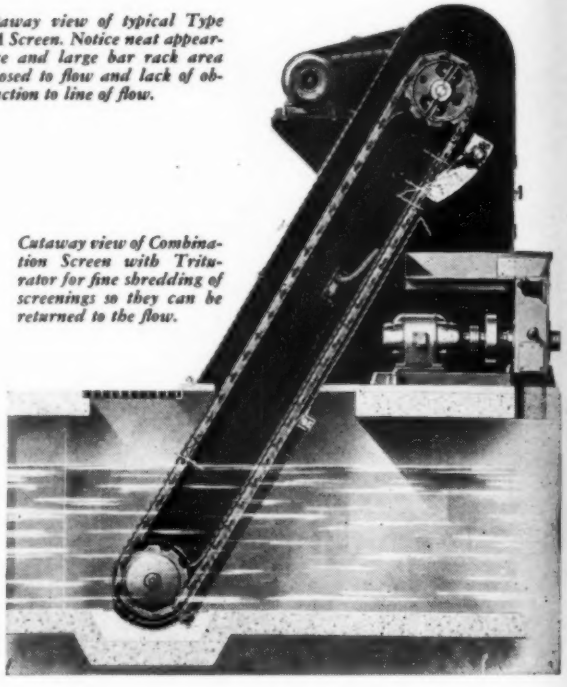
Rex Mechanically Cleaned Bar Screens assure efficient, low-cost removal of debris for virtually any range of flow or channel dimension. They are easily installed in new or existing channels and have remarkably low head loss.

These rugged screens have a number of exclusive design features that have made them the top choice for the majority of installations.

For all the facts and for application assistance, write Chain Belt Company, 1610 W. Bruce St., Milwaukee 4, Wis.

Cutaway view of typical Type MA Screen. Notice neat appearance and large bar rack area exposed to flow and lack of obstruction to line of flow.

Cutaway view of Combination Screen with Triturator for fine shredding of screenings so they can be returned to the flow.

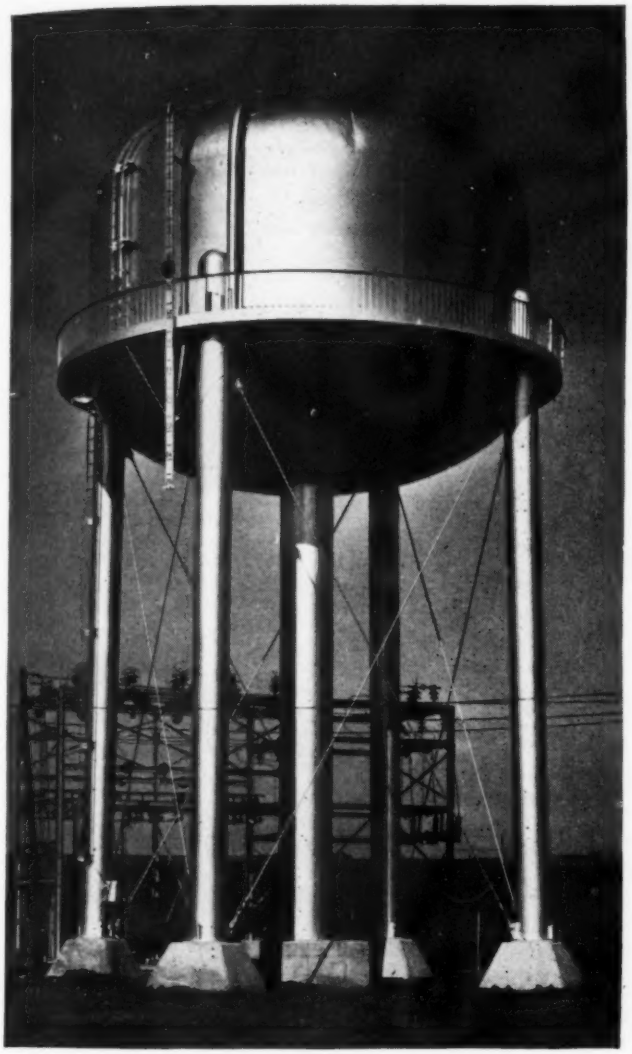


Here's What You Get With Rex:

- Unobstructed flow to rack . . . guarded chain . . . streamlined sprockets.
- Heavy bar rack without obstructing cross-members . . . bars rigidly fastened and accurately spaced.
- Generous rake width . . . high capacity.
- Special rake teeth accurately machine cut from heavy steel plate . . . designed to clean top and sides of bars to full depth.
- Rigid rake mounting with stiff-back links . . . no latches or pivots . . . rake cannot slide over accumulated screenings.
- Positive rake cleaner . . . quiet and adjustable.
- Rake Z-Metal Chain and attachments . . . corrosion and wear resisting.
- Split head-sprockets . . . easily removable.
- Special protection for important wearing parts . . . corrosion resisting.
- Drive unit fully enclosed . . . efficient . . . shear pin protection against overload.
- Head end of screen fully enclosed . . . rugged design . . . neat appearance . . . easy removal of screenings.

REX SANITATION EQUIPMENT
Member of the Water and Sewage Works Manufacturers Association
CHAIN BELT COMPANY of Milwaukee

HORTON ELEVATED TANK



The Horton elevated tank shown above is located at the new Oklahoma City, Okla., filtration plant. It holds 150,000 gals. and is used for wash water service.

●

We design, fabricate and erect many types of Horton elevated water storage tanks for municipal service. These tanks range in capacity from 50,000 gals. to 2,000,000 gals. We also build ground-level reservoirs for use where topography permits.

A *Good bet*

FOR WASH WATER SERVICE

The use of elevated storage tanks to provide wash water for filtration plants has several distinct advantages. A few of them are:

★ Filter washing usually requires water at a relatively high rate of flow for short periods. An elevated tank provides this high rate of flow without disturbing the pressure in the supply system.

★ An elevated tank may be refilled from the mains at a low rate, or with a small pump. The capacity of such a pump is not nearly as great as it would have to be to supply wash water direct.

★ When an elevated tank of sufficient capacity is used for wash water service, a standby pumping unit is not required.

In addition to providing wash water with filtration plants, Horton all-welded elevated tanks are installed to supply gravity pressure in new distribution systems. or erected when extensions are made to existing municipal water systems.

Write our nearest office for quotations when you are planning elevated water storage for any of these services. Please state capacity desired and height to bottom.

CHICAGO BRIDGE & IRON COMPANY

Chicago 4.....2198 McCormick Bldg.
New York 6.....3390-165 Broadway Bldg.
Cleveland 15.....2262 Guildhall Bldg.
Los Angeles 14.....1455 Wm. Fox Bldg.
Birmingham 1.....1586 North 50th St.
Atlanta 3.....2181 Healey Bldg.
Plants in Birmingham, Chicago and Greenville, Pa.

Tulsa 3.....1646 Hunt Bldg.
Houston 1.....5615 Clinton Dr.
Philadelphia 3.....1644-1700 Walnut Street Bldg.
Havana.....402 Abreu Bldg.
San Francisco 11.....1283-22 Battery Street Bldg.
Detroit 26.....1551 Lafayette Bldg.
In Canada: Horton Steel Works, Limited, Fort Erie, Ont.

The whole community is pleased when its water is pure and good to drink—when unpleasant tastes and odors have been removed... and Mathieson's Chlorine Dioxide treatment takes care of that!

Chlorine Dioxide destroys phenols, algae and other contaminants... is an effective bactericide as well. The Mathieson method of treating water eliminates unpleasant tastes and odors... even those which so often are the aftermath of floods, melting snow and ice.

Every water works superintendent should be familiar with the Mathieson Chlorine Dioxide treatment—the technique that is bringing good, safe water to so many communities. Write us for details.

THE MATHIESON ALKALI WORKS (INC.),
60 East 42nd Street, New York 17, N. Y.

Mathieson
CHLORINE DIOXIDE

Chlorine Dioxide... Sanitation HTH... Liquid Chlorine... PH-Plus (Fused Alkali)... Caustic Soda... Soda Ash... Bicarbonate of Soda... Ammonia, Anhydrous & Aqua... Carbonic Gas... Dry Ice... Sodium Chlorite Products... Sodium Methylate

Original Woodcut by Lynd Ward

The modern community uses cast iron pipe in more ways than is generally realized. In addition to its better known use for water, gas and sewer mains in the streets of a community, U. S. Cast Iron Pipe is also used to furnish some or all of these utility services to such facilities as airports, golf courses, swimming pools and parks. U. S. Cast Iron Pipe is widely used, too, in water filtration and sewage treatment plants.

U.S. cast iron PIPE

U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Plants and Sales Offices throughout U.S.A.

America's Newest

Photo Courtesy of: City of Miami News Bureau

Turbines . . . other power generation equipment.

Transformers — all types and sizes 1½ kva and up.

Unit substations — available in any practical size.

Motors 1 hp and up; controls; V-belt drives.

ALLIS

1847 1947
A CENTURY OF SERVICE to Industry THAT MADE America Great

One of the Big 3 in Electric Power Equipment

Southern Gateway!

That's Growing Miami . . . In Her Public Works is Much Allis-Chalmers Equipment!

MANY "CLIPPER SHIPS," flying the southern route from Europe, Africa and South America, now set their sights on the nation's newest southern gateway . . . Miami. For today, Miami has become one of the world's leading air terminals with flights to all points of the compass throughout the day and night. Long renowned as an internationally famous tourist mecca, Miami seeks added fame in the aviation and commercial world of tomorrow.

* * *

Allis-Chalmers equipment has long played an important part in Miami's efficient system of public works. Centrifugal pumps, motors and switchgear built by Allis-Chalmers, installed in the city's waterworks, have delivered year after year of dependable, trouble-free service.

Machine teamwork: Allis-Chalmers pump, motor and switchgear in Miami city waterworks.

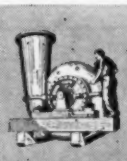
Miami's installations are typical of what Allis-Chalmers can do for all cities—large, medium and small. For the complete story of the world's widest range of public works equipment, send for Bulletin 25B6607. For prompt help with all of your public works equipment problems, call our nearest office or write: ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 2300

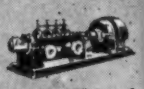
CHALMERS

Biggest of All in Range of Industrial Products!

Switchgear; power distribution equipment.



Blowers, compressors in most sizes to fit all jobs.



Centrifugal pumps; types, sizes to 160,000 gpm.

Worthington-Gamon WATCH DOG WATER METERS

The meter used by thousands of municipalities in the U. S. and abroad.

SURE TO MEET YOUR SPECIFICATIONS FOR ACCURACY, LOW MAINTENANCE, LONG LIFE

Before you invest in water meters, get acquainted with the design and performance advantages which make Worthington-Gamon Watch Dog Water Meters first choice of so many municipalities and private water companies in the United States.

WATCH DOG WATER METERS

"Watch Dog" models . . . made in standard capacities from 20 gpm up; frost-proof and split case in household sizes. Disc type, Turbine type or Compound type. Write for Bulletin.

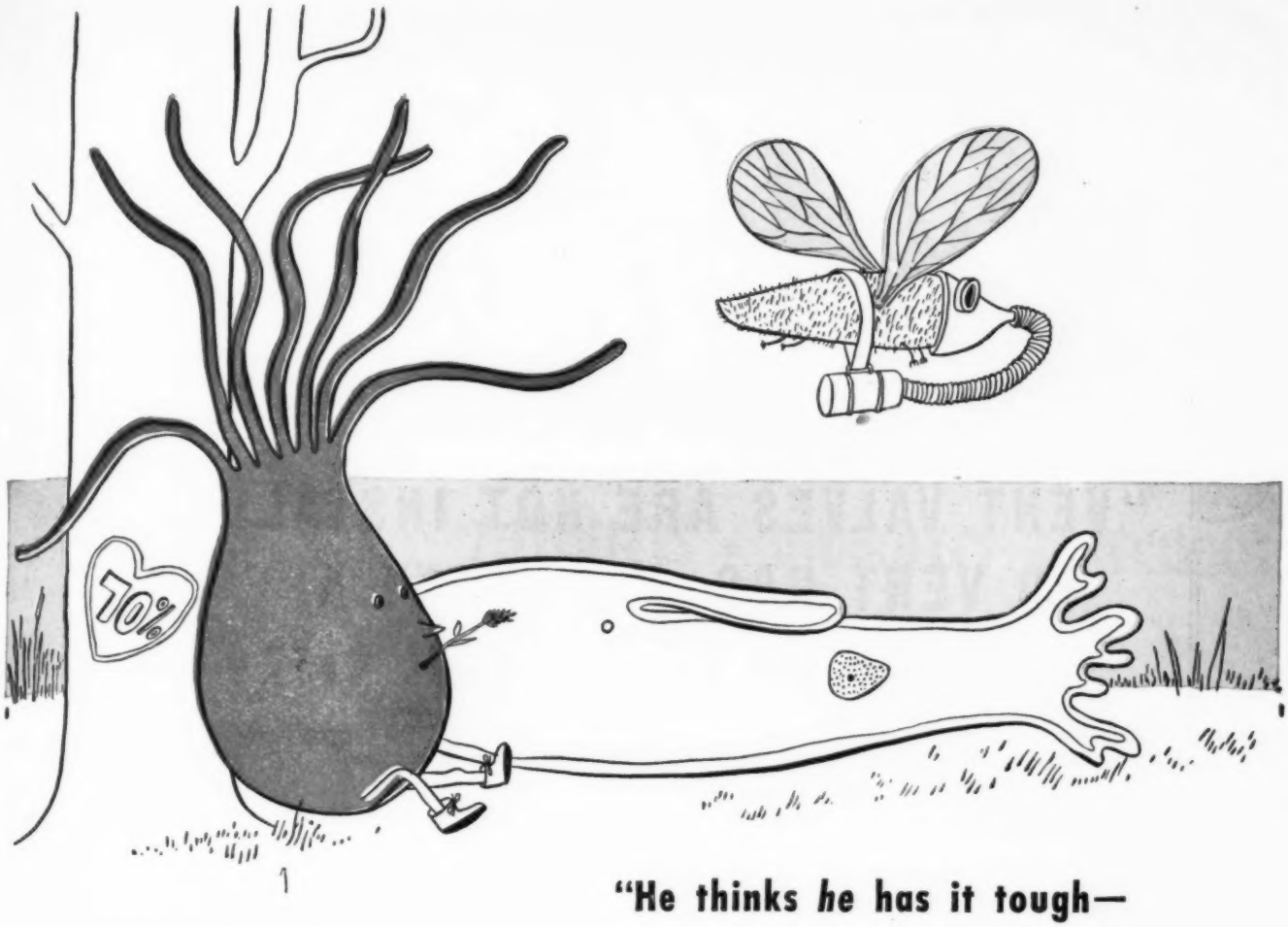
WORTHINGTON-GAMON METER COMPANY

296 South Street, Newark 5, New Jersey

Subsidiary of

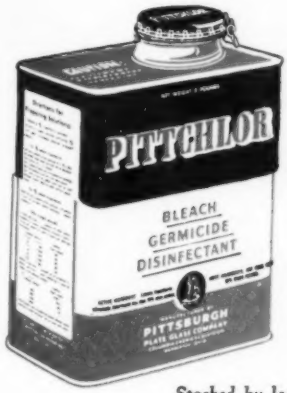
WORTHINGTON

PUMP AND MACHINERY CORPORATION



"He thinks *he* has it tough—

he should be up against



*PITTCHLOR"

Stocked by leading jobbers —in 5 lb. resealable cans (9 per case), 3-¾ lb. cans (12 per case) and 130 lb. drums.

*Reg. U.S. Pat. Office

He *does* have it tough, Orgie. But what the powerful new insecticides are doing to winged pests, chlorine has been doing for years to water-borne microorganisms and other harmful bacteria and algae. Pittchlor, a high-test calcium hypochlorite with 70% available chlorine, is being widely used for its ease in handling in the chlorination of water supplies, the treatment of sewage . . . and for many general sanitation and deodorizing purposes. Write for literature covering the uses in which you are interested.

PITTSBURGH PLATE GLASS COMPANY, COLUMBIA CHEMICAL DIVISION, FIFTH AVENUE AT BELLEFIELD, PITTSBURGH 13, PA. • • • CHICAGO • BOSTON • CLEVELAND • NEW YORK • CINCINNATI • ST. LOUIS • MINNEAPOLIS • PHILADELPHIA • CHARLOTTE • SAN FRANCISCO

COLUMBIA CHEMICALS

PAINT • GLASS • CHEMICALS • BRUSHES • PLASTICS

PITTSBURGH PLATE GLASS COMPANY

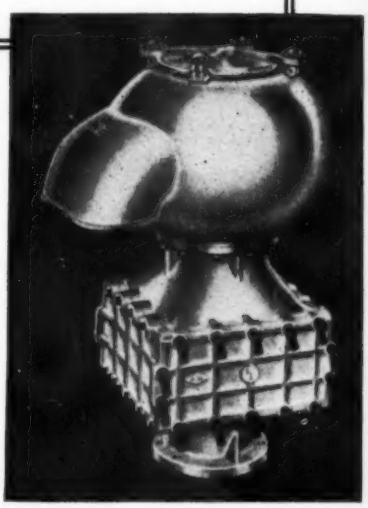
MYTH #2 EXPLODED!

"VENT VALVES ARE NOT INSTALLED TO VENT GAS . . . . THEY ARE INSTALLED TO CONTROL IT!"

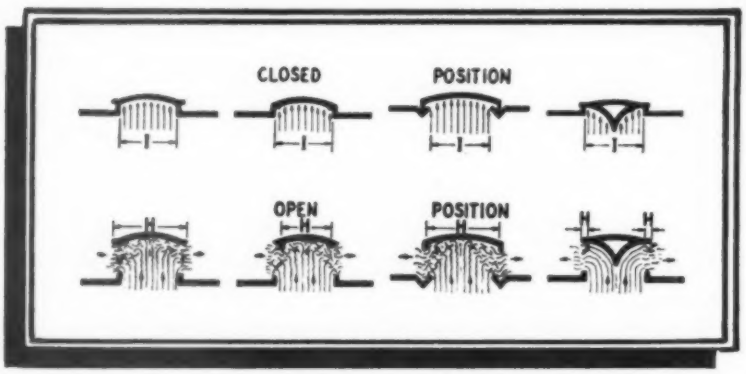
Second in a series.

If venting were the only reason for using a vent valve, you might as well install an open nipple on your tank or not even bother to put a roof on. TANK VENTS WERE DESIGNED TO PERMIT GAS CONTROL. Gas control makes certain that there is no more gas in the tank than it can handle and that excess gas goes to where it is needed. To acomplish this, you need a valve that will not depressure the tank more than is absolutely necessary.

Static pressure varies when temperatures change and when contents are put into or taken out of the tank. When the valve opens to allow an outrush of gas to relieve this pressure, velocity of the escaping gas creates a kinetic energy on the valve pallet which tends to hold the valve open for a longer period of time. Unless the effect of this velocity pressure is taken care of in valve design, it will allow excess gas to escape, thereby creating a dangerous fire hazard. The loss of this excess gas is called "blow-down." It can be eliminated by scientifically streamlining the valve pallet. "VAREC" Vent Valves are designed with a patented hyperbolic pallet for this very purpose. They are the ONLY tank vents which provide maximum capacity with minimum "blow-down."

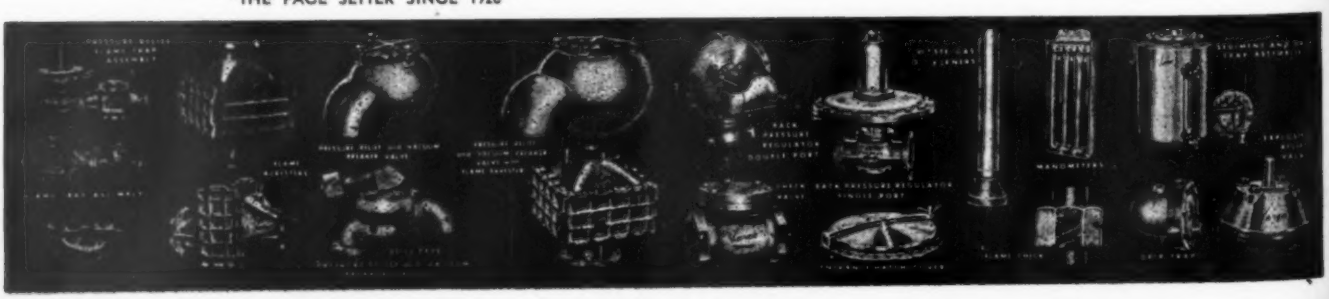


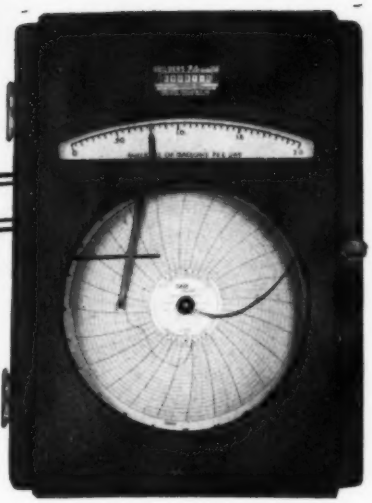
"VAREC" approved Conservation Vent Valve and Flame Arrester



The drawing at the left illustrates the flow of gas through vent valves having dfferent types of pallets. You can readily see that the impact area ("I") of flat disk, concave and hyperbolic pallets is the same for valves with the same port dimensions but the "huddling" area ("H") in the "VAREC" Hyperbolic Pallet is much less than the other types. This is one of the reasons why you have a minimum "blow-down" get true gas control in "VAREC" Vent Valves.

THE VAPOR RECOVERY SYSTEMS COMPANY
COMPTOM—CALIFORNIA—U.S.A.
New York, Chicago, Ill., Cleveland, O., Houston, Tex.
"THE PACE SETTER SINCE 1928"





BUILDERS FLO-WATCH METER

Flo-watch METER WATCHES FLOW *Mechanically*

TOTALIZES • INDICATES • RECORDS

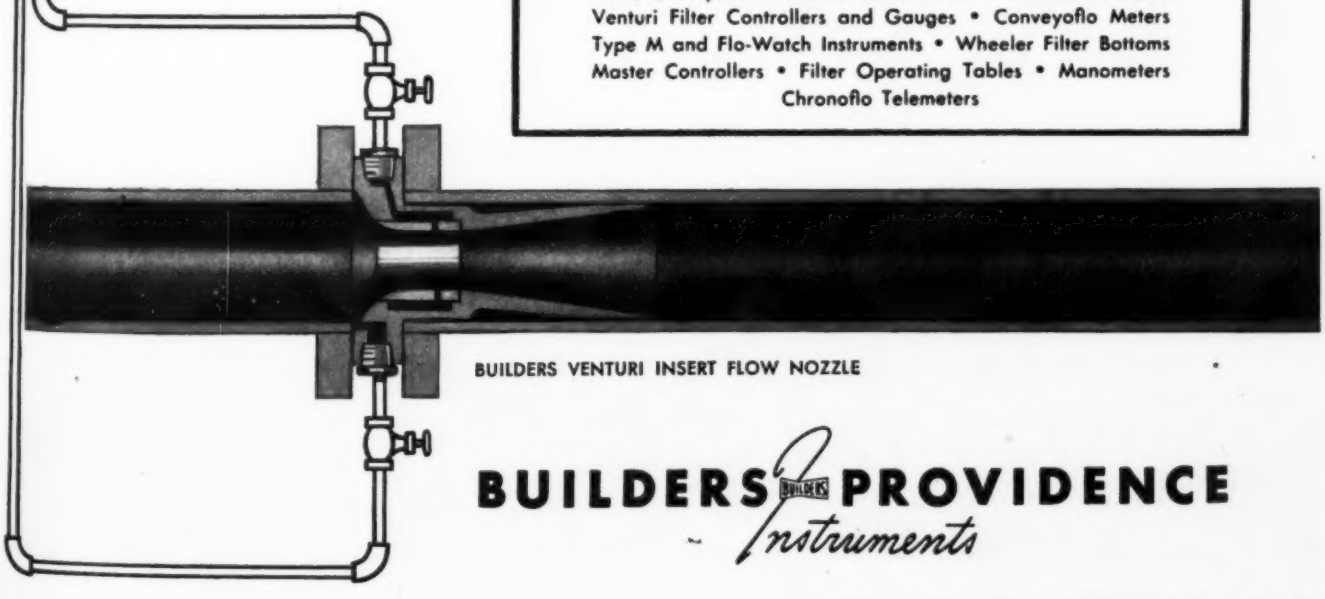
One *rugged* and *simple* mechanical instrument, — Builders Flo-Watch Meter — located on the control panel, provides complete flow information over distances up to 100 feet. The Flo-Watch Meter totalizes, indicates, and records all flow of liquid, air or gas over a range of from 10% to 100% of rated capacity. The seven-figure counter is *direct reading* i.e., shows gallons, pounds, etc., without odd multipliers. Uniform graduations and exceptionally large scale permit the indicator to be read from a distance. The twelve-inch recording chart has *uniformly spaced* graduations over the entire flow range and is available in any units of flow.

Only two small pressure tubes are required to connect the Flo-Watch to any differential producer — Venturi Tube, Nozzle or Orifice. The Builders Venturi Insert Flow Nozzle shown with the Flo-Watch provides economical yet accurate metering . . . the Flo-Watch Instrument, actuated by changes in the mercury level in its U-tube wells, responds within 1% to variations in flow through the Nozzle. The Insert Nozzle is mounted between standard pipe flanges, with pressure piping connected to the mounting flange. It is unnecessary to drill the pipe-wall or flanges, which greatly simplifies correct installation.

For Bulletins 318B and 356, address Builders-Providence, Inc., (Division of Builders Iron Foundry)
10 Codding St., Providence 1, R. I.

BUILDERS PRODUCTS

Venturi, Propelofio and Orifice Meters • Kennison Nozzles
Venturi Filter Controllers and Gauges • Conveyoflo Meters
Type M and Flo-Watch Instruments • Wheeler Filter Bottoms
Master Controllers • Filter Operating Tables • Manometers
Chronoflo Telemeters



BUILDERS VENTURI INSERT FLOW NOZZLE

BUILDERS PROVIDENCE
Instruments

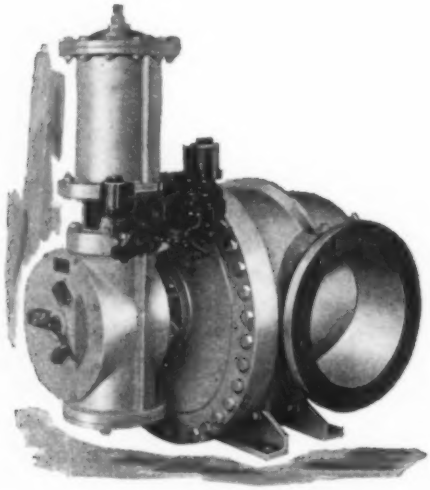
Dangerous Days -

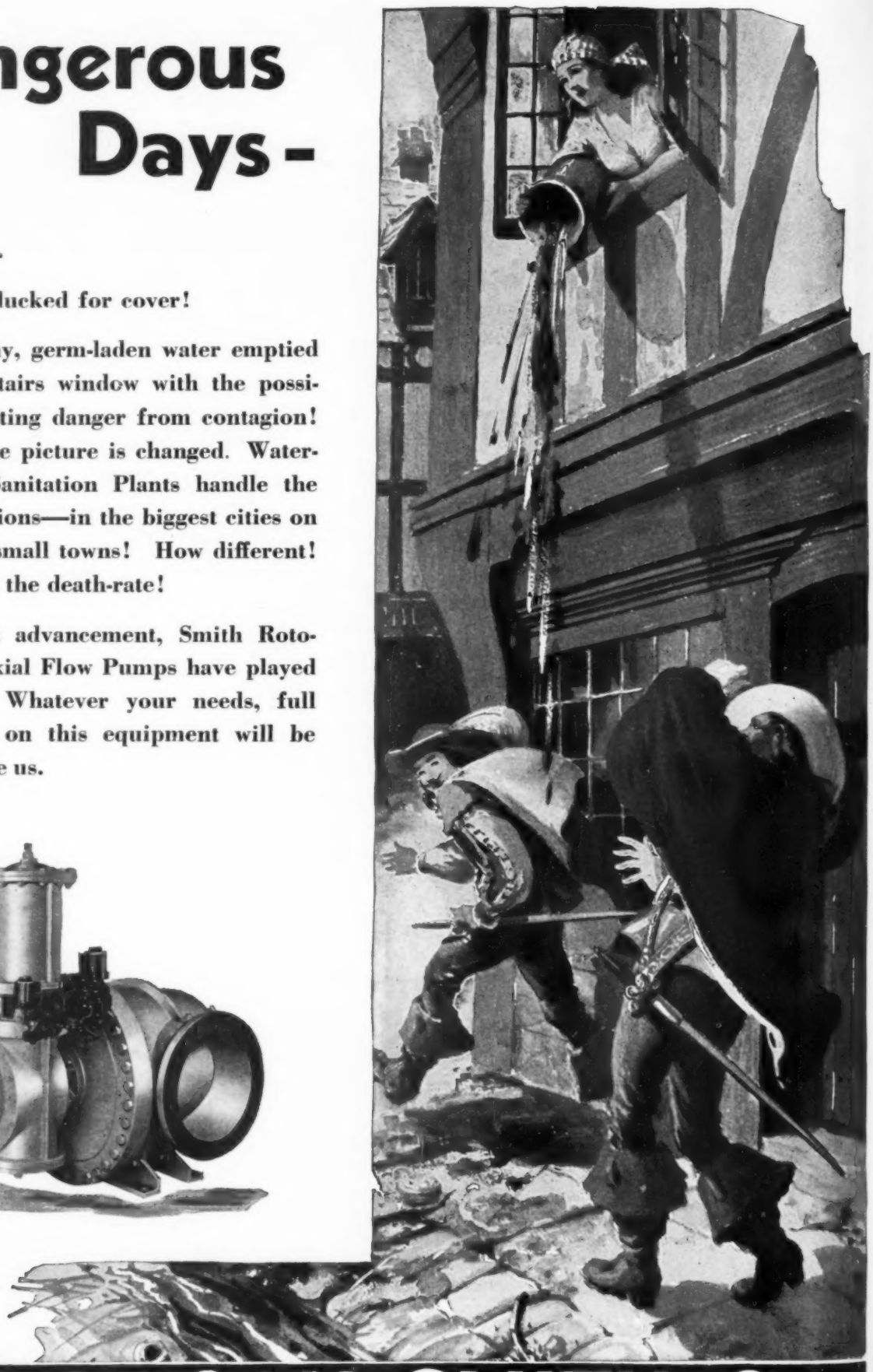
SPLASH! . . .

And people ducked for cover!

A jar of filthy, germ-laden water emptied from an upstairs window with the possibility of creating danger from contagion! But today, the picture is changed. Waterworks and Sanitation Plants handle the needs of millions—in the biggest cities on down to the small towns! How different! What a cut in the death-rate!

In this great advancement, Smith Rotovalves and Axial Flow Pumps have played their parts. Whatever your needs, full information on this equipment will be useful. Write us.



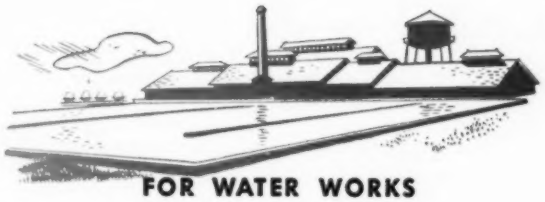


S. MORGAN SMITH Co.

YORK. PENNA. U.S.A.

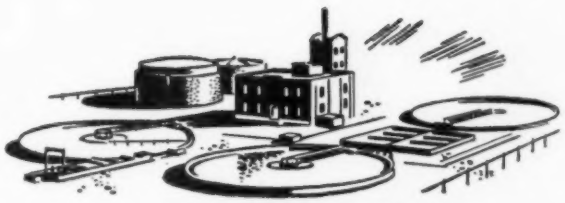
GENERAL CHEMICAL "ALUM"

...Equally Efficient for Coagulation of WATER and SEWAGE!



FOR WATER WORKS

1. Produces crystal clear water.
2. Gives better floc formation.
3. Promotes better settling and longer filter runs.
4. Aids in reduction of tastes and odors.
5. Has no chlorine demand.
6. Is a *low cost* coagulant.
7. Superior in tests against other coagulants.
8. High in quality. Its constant uniformity can be depended upon.



FOR SEWAGE PLANTS

1. Clean, easy to handle.
2. Dry feeds well or dissolves readily for solution feeding.
3. Simple application. Requires only low cost feeding apparatus and minimum attention.
4. Clear, colorless effluents are possible.
5. Sludge digests readily.
6. Treated digested sludge dries quickly with minimum of odor.
7. Chlorine consumption is cut due to lower demand of clarified sewage.
8. Economical to use.

Aluminum Sulfate is almost universally accepted by water experts as the best coagulant for removal of turbidity, color and bacteria from water . . . and General Chemical Aluminum Sulfate is the outstanding choice the nation over. That's because its high quality and constant uniformity have given it a time-tested reputation for reliability among operating men in towns and cities all over America.

Municipal officials in charge of sewage treatment also find that clarity of sewage effluent is easily obtainable with General Chemical Aluminum Sulfate for the many reasons outlined above. For your water and sewage disposal systems, specify General Chemical "Alum"—*preferred by most American cities.*

GENERAL CHEMICAL COMPANY

40 RECTOR STREET, NEW YORK 6, N. Y.

Sales and Technical Service Offices: Albany • Atlanta • Baltimore • Birmingham • Boston Bridgeport • Buffalo • Charlotte • Chicago • Cleveland • Denver • Detroit • Houston Kansas City • Los Angeles • Minneapolis • New York • Philadelphia • Pittsburgh Providence • San Francisco • Seattle • St. Louis • Wenatchee • Yakima (Wash.)

In Wisconsin: General Chemical Wisconsin Corporation, Milwaukee, Wis.

In Canada: The Nichols Chemical Company, Limited • Montreal • Toronto • Vancouver

BASIC CHEMICALS

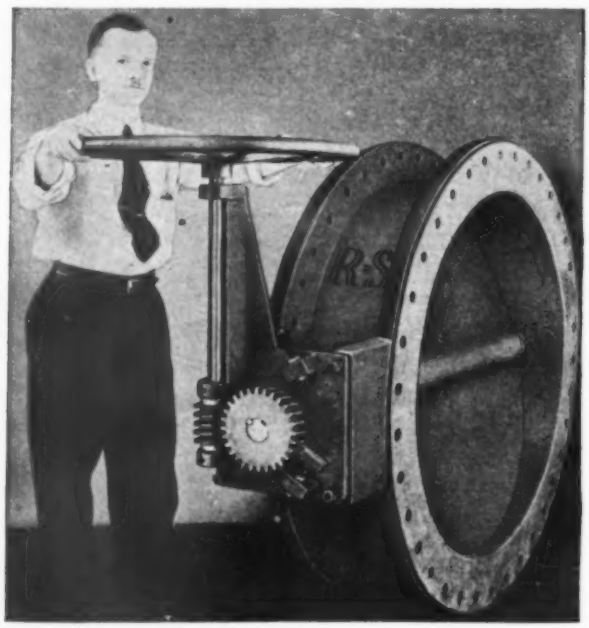
GENERAL CHEMICAL COMPANY

FOR AMERICAN INDUSTRY

SEPTEMBER, 1947

R-S valvEvents

ISSUED PERIODICALLY BY R-S PRODUCTS CORPORATION, PHILADELPHIA 44, PA., FOR THOSE CONCERNED WITH FLOW CONTROL AND SHUT-OFF



One of the Large Size R-S Rubber-seated Valves

Picture shows an R-S 42-inch Standard Iron Valve equipped with R-S rubber spool (patent pending) for positive shut-off.

The replaceable rubber spool is available for all R-S Valves up to 72-inch. We are working on sizes up to 108-inch diameter.

Many and rigorous tests have proved the remarkable wearing quality of the rubber spool. One user, handling powdered glue, arranged a test which would automatically open the valve wide, then slam it tight with a 50-pound counterweight. At the end of 9000 consecutive closings from the wide open position the valve was still drop-tight at 115 p.s.i.

Perfect closure is attained even at the shaft-bosses, by the wedge-like action of the disc as it closes within the spool and bunches up the rubber around its periphery.

Replacement of the rubber spool is simple, though it has never yet been necessary in service. Valve body is freed from the pipe, disc removed, and the spool folded and slipped out of the valve. A new spool is folded and slipped in similarly. The flanges are smoothed down and the valve reassembled. No regular gaskets are required when the rubber spool is used and this fact alone represents a substantial economy.

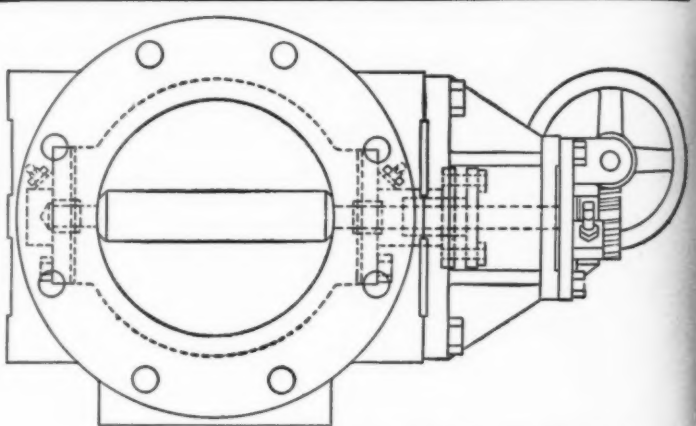
The R-S Rubber-seated valve affords remarkably good resistance to abrasion.

Lest You Forget!

You can't buy R-S Valves in the corner drug-store but there is a surprising number of places where you *can* buy them or reach a representative who will call on you with drawings, pictures, data, characteristic curves, prices and whatever else you need to know. We can also supply you direct from the factory with very complete information if you will inform us of your requirements. Tell us size of valve, type of flanges, material to be controlled, line pressure, pressure drop, operating temperature, rate of flow, and method of control desired.

The list of representatives' locations is complete as this issue of R-S ValvEvents goes to press, but it is a steadily growing list. In all these cities you will find the representative's address and phone number in the local phone book under the heading "R-S Products Corporation, Valves." *The list of representatives' locations follows:*

Atlanta
Appleton, Wis.
Baltimore
Birmingham, Ala.
Bloomington, Ill.
Boston
Buffalo
Caracas, (Venezuela)
Charlotte, N. C.
Chattanooga
Chicago
Cincinnati
Cleveland
Corpus Christi
Denver
Des Moines
Detroit
Houston
Indianapolis
Johnson City, Tenn.
Knoxville
Los Angeles
Milwaukee
Minneapolis
Monterrey, (Mexico)
New York
Panama, (Panama)
Philadelphia
Pittsburgh
Portland, Ore.
Richmond, Va.
St. Louis
San Francisco
Santiago, (Chile)
Seattle
Syracuse
Tulsa
Youngstown



New 50-pound Valve

Drawing shows details of the new R-S 50-pound Class B Iron Valve. This was designed especially for rugged hydraulic service with the usual R-S safety factor to care for line stresses, water-hammer, and other service abuse. The new valve is in demand for circulating water lines for condenser service. It is available with 25-pound or 125-pound American Standard flanges. Like all R-S Valves, it may be ordered in any material that can be cast or welded, including steel with Series 15 150-pound American Standard flanges. The new valve has the characteristic R-S angular seating disc and may be equipped with the patented R-S Rubber Spool for positive shut-off. (See pic upper left).

Complete R-S Valve Installation Data

Engineers like the complete dimensional data supplied for R-S Valves. Dimensions are tabulated by standard sizes under stock types and identified by letters corresponding to detailed drawings which accompany the tables. Six full pages of R-S Products' Catalog No. 14-B (copy on request to R-S Products Corporation, Wayne Junction, Philadelphia 44, Pa.) are devoted to this basic installation data.

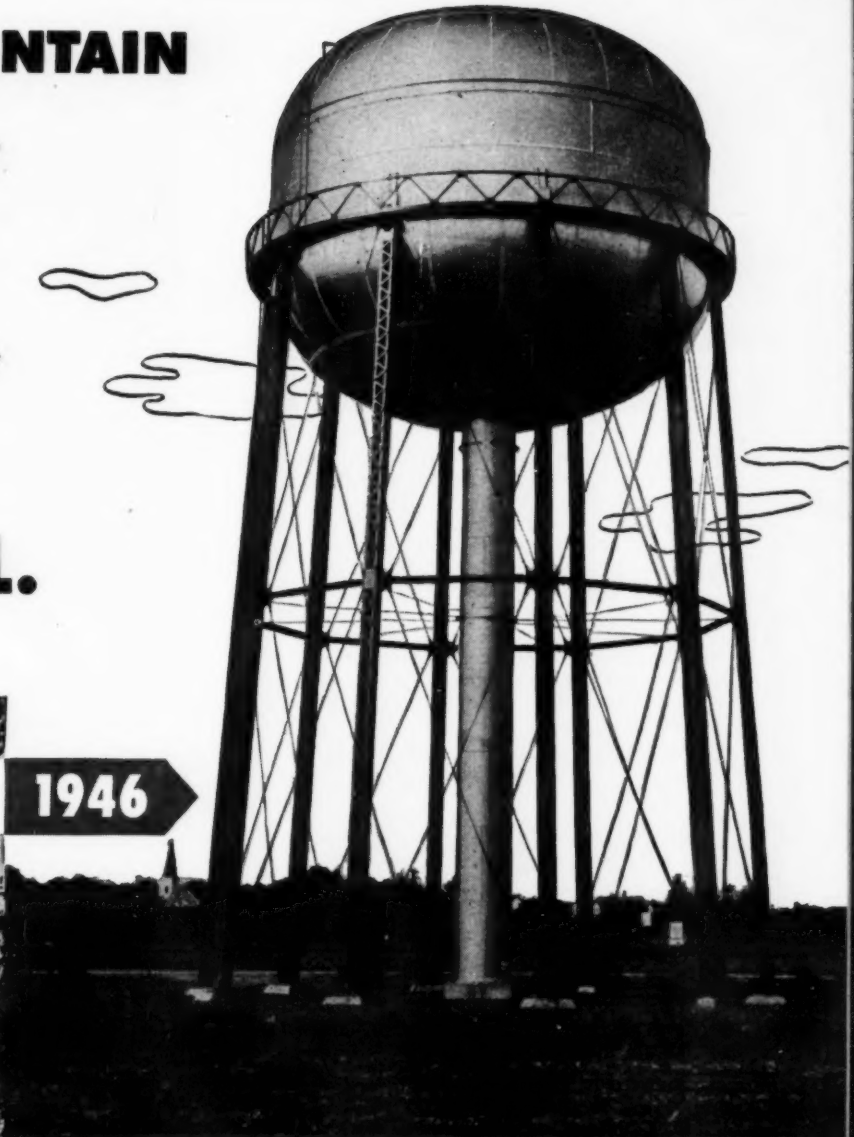
JM Leo P-J2

HELPING TO MAINTAIN

Better Water Service

IN FAST-GROWING

STOCKTON, CAL.



ELEVATED STEEL TANKS

by

PITTSBURGH ·DES MOINES

With an excellent service record established by its original Pittsburgh-Des Moines Elevated Steel Tank installed six years ago, the California Water Service Company at Stockton, California, has recently added a second P-DM tank to serve the northern section of the city, where it has been successful in maintaining a more uniform pressure than was formerly available. With a wide-ranging water system, Stockton takes its water supply from a number of deep wells located at pumping stations in various points throughout the distribution system. These Pittsburgh-Des Moines Elevated Steel Tanks do their full share in lowering pumping costs and aiding in the equalizing of water pressures around the clock.

For a detailed consultation on the better water storage needs of your own community, write—without obligation of any kind.

PITTSBURGH · DES MOINES STEEL CO.

PITTSBURGH, PA., 3418 NEVILLE ISLAND—DES MOINES, IOWA, 919 TUTTLE STREET
NEW YORK, ROOM 918, 270 BROADWAY · CHICAGO, 1222 FIRST NATIONAL BANK BUILDING
DALLAS, 1223 PRAETORIAN BUILDING · SAN FRANCISCO, 625 RIALTO BUILDING
SEATTLE, 526 FIRST AVENUE, SOUTH

everywhere...

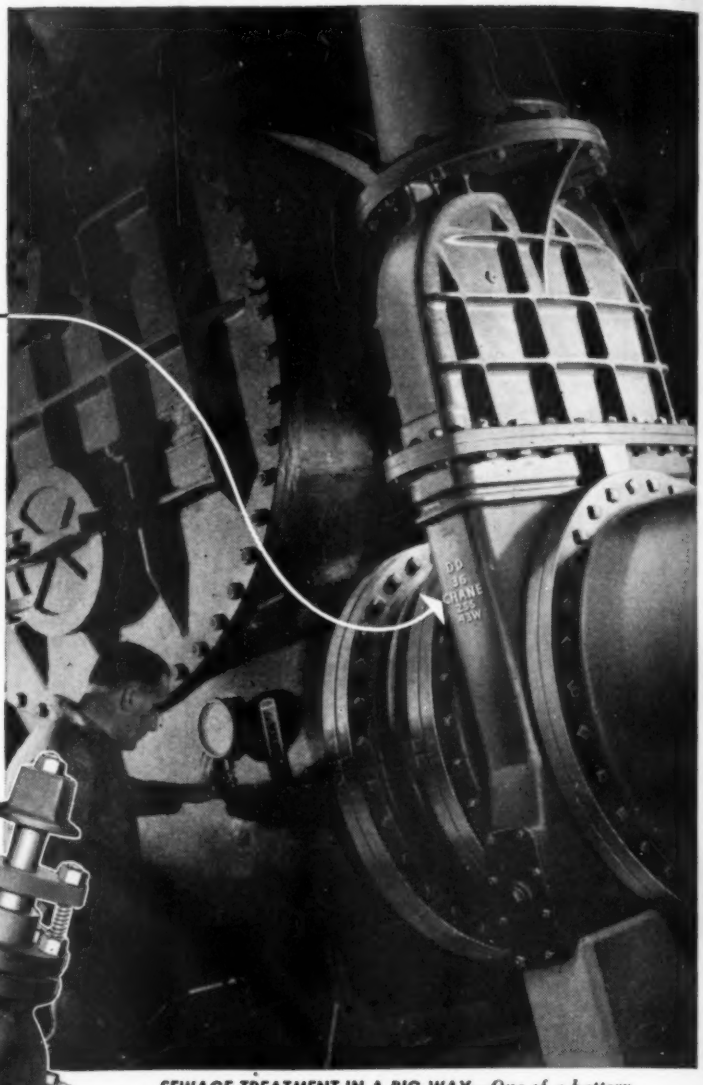
you see this name on valves

... In water and sewage works ... in communities big and small. And for good reason!

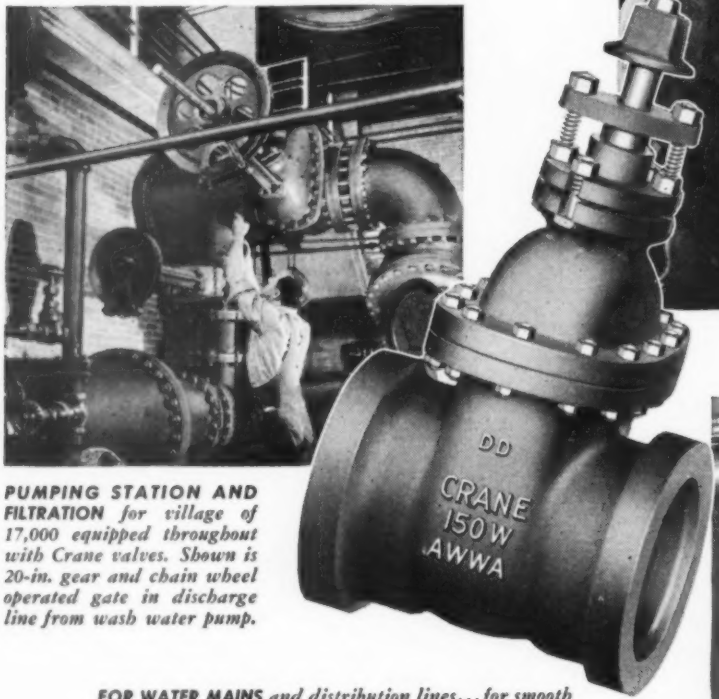
Together they grew up ... the nation's public water services and Crane. Together, by steady development of flow control equipment, they have safeguarded public health.

In valves as in fittings, Crane Quality meets today's highest standards for water supply and sewage disposal practices. To the men who specify for these services ... to the men who manage and maintain them ... Crane Quality assures maximum value and dependability in piping equipment.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Nation-wide Service Through Branches and Wholesalers



SEWAGE TREATMENT IN A BIG WAY—*One of a battery of Crane 36-in. double disc gate valves in water lines to exhaust steam condensers from turbo-blowers.*



PUMPING STATION AND FILTRATION *for village of 17,000 equipped throughout with Crane valves. Shown is 20-in. gear and chain wheel operated gate in discharge line from wash water pump.*

FOR WATER MAINS *and distribution lines... for smooth and positive control ... long life ... for extra dependability when you need it most ... choose Crane No. 480½ A.W.W.A. double disc iron gate valves. Brass trimmed; non-rising stem; hub ends. Sizes up to 12-in. rated at 200 pounds; sizes 14 to 36 in., 150 pounds. Complete specifications on page 126 of your Crane Catalog.*

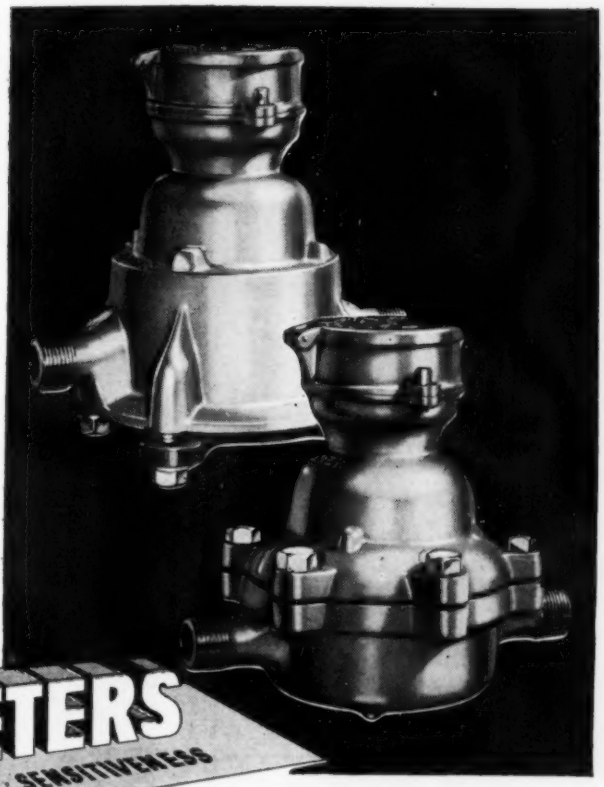
"SMALL TOWN" SEWAGE *and industrial waste disposal plant, showing Crane-equipped pump room handling hot and cold water, air, sewage gas, and sludge.*

VALVES · FITTINGS · PIPE

CRANE

PLUMBING AND HEATING

"Badger took our water utility out of the 'red' and into the money column"



. . . "did this in a year's time," writes a mid-west city official. "We are still using Badger Meters . . . a very worthy product, honestly made, honestly priced, and we have found your company to be more than willing to help us with any water utility problem."

In over 5,000 communities, waterworks men know "It pays to BUY BADGER."

BADGER METER MFG. CO., MILWAUKEE 10, WIS.

BADGER Water METERS

ACCURACY · LOW COST MAINTENANCE · DURABILITY · SENSITIVENESS

BRANCH OFFICES:

NEW YORK CITY • PHILADELPHIA • WORCESTER, MASS.
SAVANNAH, GA. • CINCINNATI • CHICAGO • KANSAS CITY, MO.
WACO, TEX. • SALT LAKE CITY, UTAH • PORTLAND, ORE. • SEATTLE, WASH. • LOS ANGELES

LUDLOW EQUIPMENT

Proved by the Past – Fit for the Future

In the last analysis, the best indication of future service in water works equipment is its past record. Through the years—changing systems, higher pressures, lower budgets, wartime emergency — Ludlow Valves, Gates and Hydrants have served efficiently and faithfully. You may continue to rely on them for constant service, low upkeep, resistance to wear and fewer replacements. You may rely, too, on Ludlow engineers to consider your problems their own, making honest recommendations and giving accurate estimates.

Write today for full information

LUDLOW DOUBLE DISC GATE VALVE

The parallel seat, double wedge type slide gate valve, developed and perfected by Ludlow, provides a number of essential benefits. For instance:

- **Smooth, Positive Operation.** Gates positioned **directly** opposite ports before wedging, and entirely unwedged **before** being raised.
- **Positive Closure**—even after years of service in the open position; flexible-action gates **self-adjusting** to seats.
- **Self-Cleaning.** Rings cleaned **throughout entire stroke. No internal guides** to cause foul-up.
- **Ready Replacement of Parts.** Simple construction with ample tolerances, permitting ready replacement of parts.

Outside Screw and Yoke Type

←**Iron body, bronze mounted—tested at 350 lbs. hydrostatic pressure. List 44—sizes 2" to 12"—200 lbs. working pressure. List 66—sizes 14" to 48"—150 lbs. working pressure.**

Iron body, bronze mounted → complying with latest A.W.W.A. Specifications. Tested at 300 lbs. hydrostatic pressure. Sizes 2" to 48".

A.W.W.A. Double Disc Gate Valve

←Iron body, bronze mounted—low pressure valves. List 3 Valves made in sizes 2" to 48" and can be furnished with Hub, Flanged, Universal, Spigot and Screwed Ends.

Valve shown with Hub Ends and without gearing. Also available with gearing or outside screw and yoke—and flanged ends.

←Hydraulic Cylinder, iron body, bronze mounted—manufactured in all sizes for any desired test or working pressures. Can be operated by four-way cocks or remotely controlled by solenoid valves.

Flanged End Standard Gate Valve with Cast Iron Bronze Lined Hydraulic Cylinder.

IMMEDIATE DELIVERY

Hub End Double Disc A.W.W.A. Gate Valves

also

Normal Delivery on Larger Size Valves

and

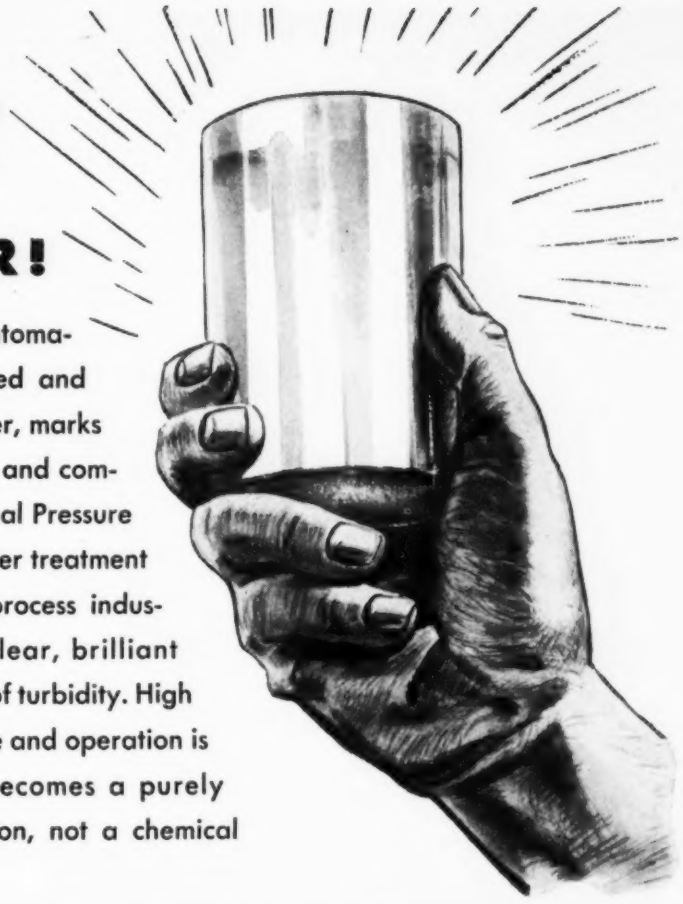
Rapid Delivery

on

HYDRANTS

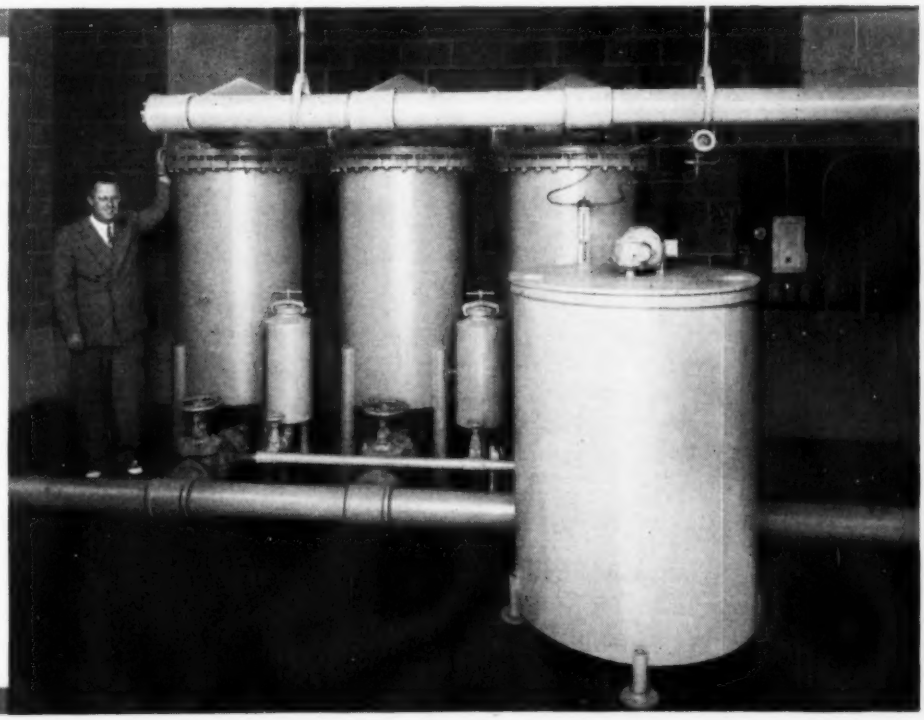
The LUDLOW VALVE MFG·CO·INC· TROY·N·Y· SINCE 1866

HERE'S TO *Clear* WATER!



%Proportioneers% war-born Diatomaceous Earth Filter, now enlarged and perfected as the Pur-O-Cel Filter, marks a great advance in efficiency and compactness over the conventional Pressure Type sand filter. Small water treatment plants, swim pools and process industries can today have clear, brilliant water, completely free of turbidity. High filtration rates are safe and operation is simple . . . filtering becomes a purely mechanical operation, not a chemical process.

The **PUR-O-CEL** is a pressure type filter using thin mats of interlaced particles of diatomaceous earth instead of a sand bed. The filter is first precoated with diatomaceous earth and then is fed a body coat which keeps the filter porous and permits high filtration rates over long periods. Simple backwashing, without disassembling, quickly restores Pur-O-Cel to its original efficiency.

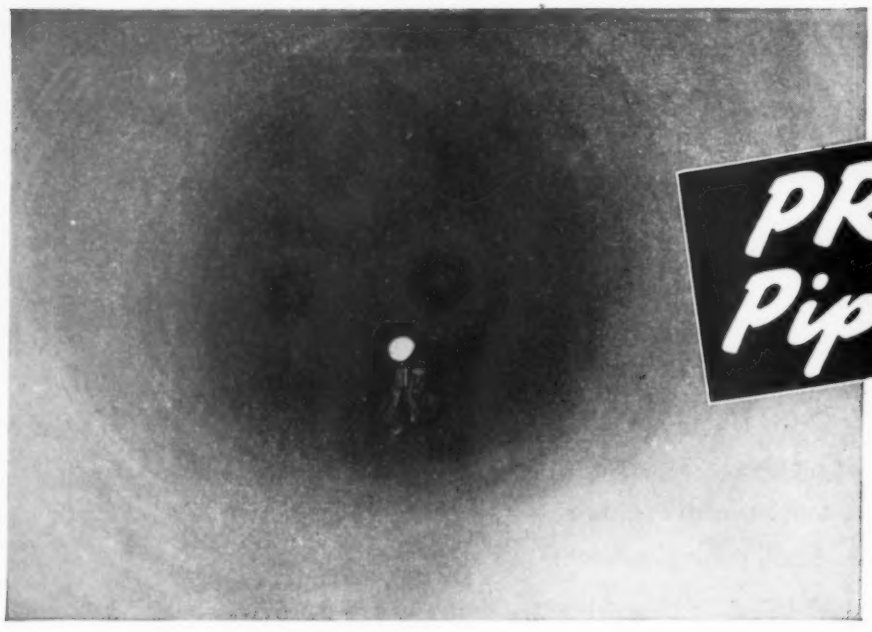


Bring your water clarification process up to date with this new method of filtering.

Write for Bulletin 1550.

% PROPORTIONEERS, INC. %

9N CODDING STREET, PROVIDENCE 1, R. I.



Interior of a 48" rivetted steel water main with cement lining by Preload

PRELOAD Pipe Lining

HOW PIPE LINING CAN COST LESS THAN THE YEARLY INCREASE IN EARNING POWER IT MAKES POSSIBLE

If there is a ready market for additional water in your community, the increased earning power of your water main due to increased capacity made possible by PRELOAD Pipe Lining, can offset the cost of pipe lining.

To illustrate this point we have taken figures from an actual job. If the increased capacity of 38,000,000 gallons per day could all be sold at 5 cents per 1000 gallons, a not unreasonable assumption in this day of heavy water service demands and expanding industrial use, the results would be as follows:—

INCREASED CAPACITY

Combined capacity after cleaning & lining	83,000,000 G.P.D.
Combined capacity before cleaning & lining	45,000,000 G.P.D.
Increased Capacity	38,000,000 G.P.D.

POTENTIAL EARNING POWER

38,000,000 G.P.D. @ 5c per 1000 gallons	$ 1,900 per day
	or
Potential Increase in Earning Power	$ 700,000 per year
Entire Cost of Cleaning and Lining	$ 629,800
Surplus of 1 year's earning over cost	$ 70,200

CAPITAL SAVINGS

Estimated cost of new 48" pipe line	$2,362,050.00
Cost of Rehabilitation of existing line	$ 629,800.00
Capital Savings	$1,732,250.00

PRELOAD Cement Lining, utilizing tried and tested Preload Equipment, is at your service for conservation of your water main investment, possible increase in earning power, and increased flow capacity.

Send for our Pipe Lining Bulletin

PRELOAD ENTERPRISES INC.

420 LEXINGTON AVE., NEW YORK, N. Y.

Designers and Builders of Prestressed Concrete Storage Tanks and Pressure Pipe
Prestressed Concrete Bridges and Cement Lining of Pipe in Place

The Preload Corporation
New York—Boston—Washington

Preload Central Corporation
St. Louis—Chicago—Kansas City

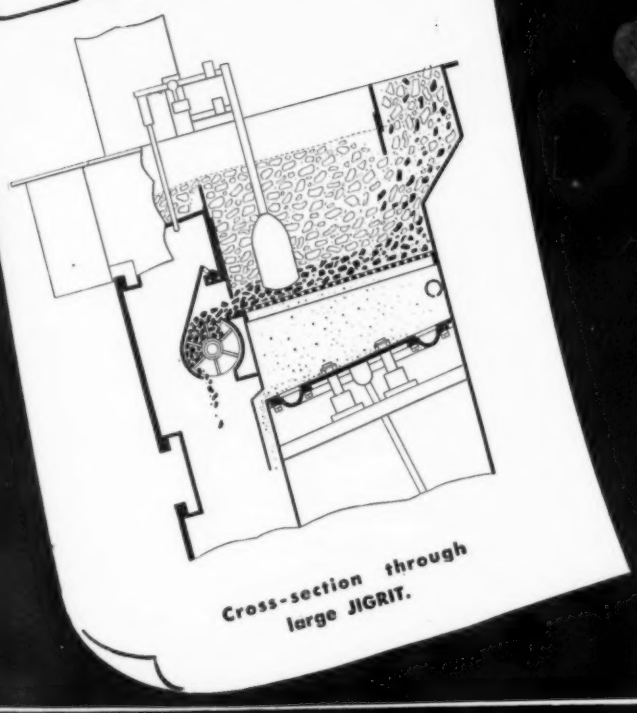
PRELOAD TRADE MARK

Preload Pacific Corporation
San Francisco—Los Angeles

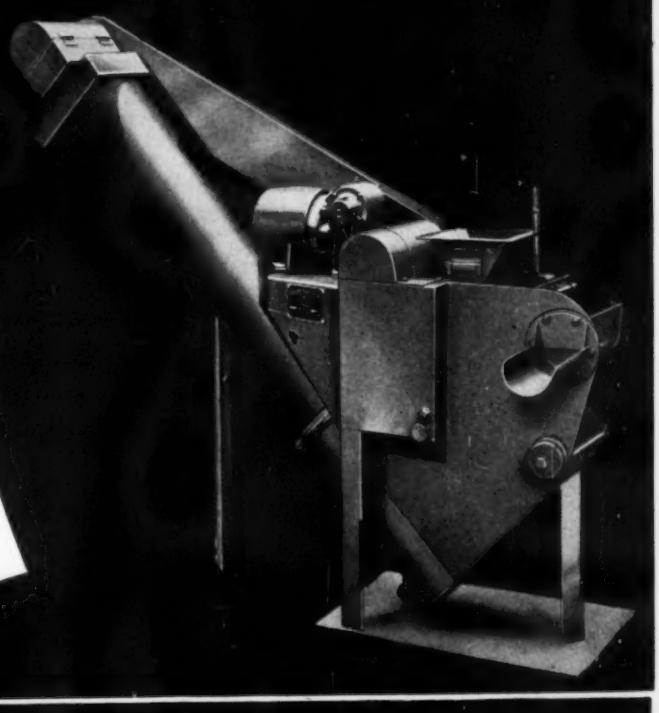
The Preload Co. of Canada, Ltd.
Montreal—Toronto—Halifax

JIGRIT

Typical layout for a large plant, combining both Scraper and V-Bucket type conveyors with a large JIGRIT. Washes grit completely free of organic solids and automatically classifies products. (Pat'd.)



Cross-section through large JIGRIT.



JEFFREY

ESTABLISHED 1877

VITRIFIED CLAY PIPE SOLVES LOS ANGELES ABRASION PROBLEM

43,715 FEET OF VITRIFIED CLAY PIPE are going into new sanitary lines for 183 acres of residential area in the Pacific Palisades Sewer District of Los Angeles. Standard-Strength Clay Pipe is being used generally and Extra-Strength Clay Pipe wherever needed to resist extra-heavy loads of deep trenches. This project is supervised by Lloyd Aldrich, City Engineer. Like countless other cities, Los Angeles has been specifying dependable Clay Pipe for many years.

CLAY PIPE NEVER WEARS OUT!

LATEST SANITARY SEWER CONSTRUCTION in the Pacific Palisades District of Los Angeles is on such a steep grade that it challenged engineering ingenuity. Think of the abrasion in sewer lines that drop down slopes *as steep as 122%!* Not just another 8 miles of Vitrified Clay Pipe, this line drops down from high bench land to a collecting sewer in Las Pulgas Canyon, creating a high-velocity abrasive flow that only a material thoroughly fused and hardened by fire (vitrified) could withstand.

Experienced engineers realize that the pipe is a small item of cost in the original sewerage installation, but the prime factor in the life of the job and its true ultimate cost. That's why Vitrified Clay Pipe saves tax-payers thousands of dollars; especially where sewage and soil conditions ordinarily cause corrosion, rusting or disintegration and quick failure. Vitrified Clay Pipe can't rust, corrode or decompose. It withstands abrasion. It *never* wears out!

Write for information on *your* Clay Pipe problem.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

111 W. Washington St., Chicago 2, Ill.
522 First National Bank Bldg., Atlanta 3, Ga.
1105 Huntington Bank Bldg., Columbus 15, Ohio
703 Ninth and Hill Bldg., Los Angeles 15, Calif.

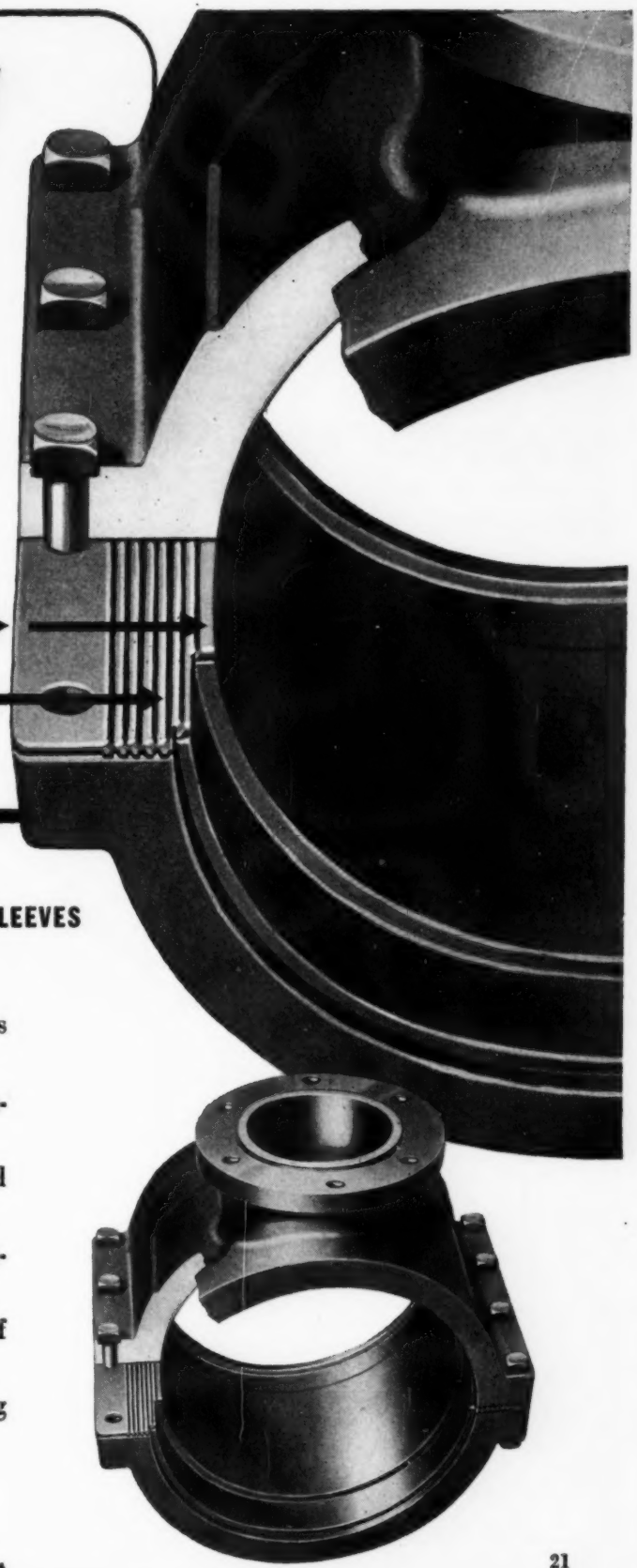
CLAY PIPE

C-447-2

NEW!

*RIBBED GASKET PREVENTS LEAKS AND STRAINS

1. *COVERS FULL WIDTH AND LENGTH OF FLANGE*
2. *RAISED PREFORMED RIBS*



FURNISHED WITH ALL SMITH BOLTED TAPPING SLEEVES

The raised ribs are the unique feature of this new lead gasket. When the sleeve halves are assembled on the main, the raised ribs are compressed *first* and then the balance of the gasket is compressed, assuring a permanently tight, leak-proof sleeve assembly, free from strains and casting distortion.

* Patent Applied For

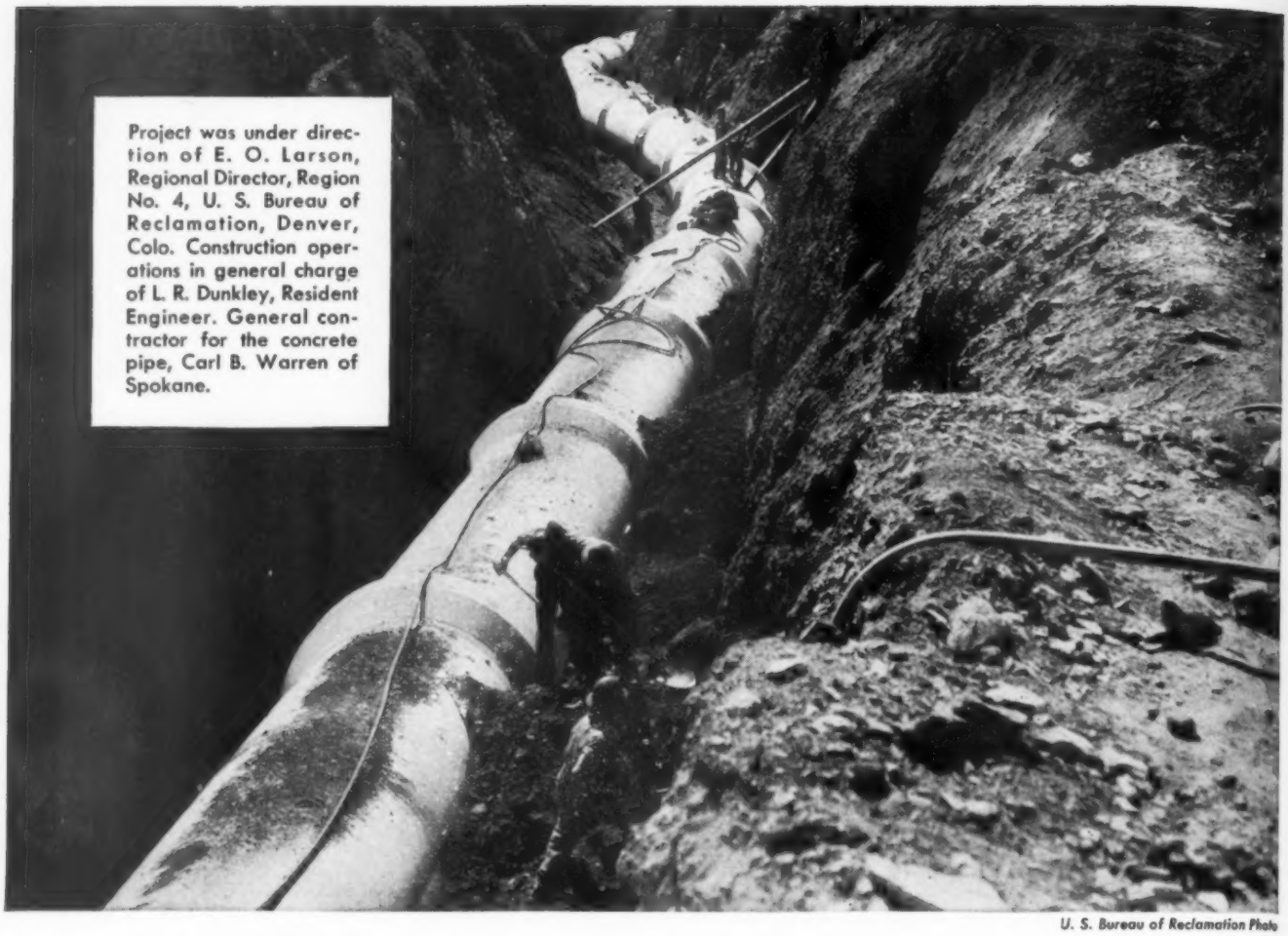
21

FIRE HYDRANTS
GATE VALVES
CHECK VALVES
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES



Project was under direction of E. O. Larson, Regional Director, Region No. 4, U. S. Bureau of Reclamation, Denver, Colo. Construction operations in general charge of L. R. Dunkley, Resident Engineer. General contractor for the concrete pipe, Carl B. Warren of Spokane.

U. S. Bureau of Reclamation Photo

CONCRETE PIPE

meets all requirements for water lines

LARGE SCALE installations of water lines for many years have proved that incrustation does not occur to impair the carrying capacity of concrete pipe. Taste, odor and dirty water difficulties are minimized. Concrete pipe meets all other essential requirements for water lines including moderate first cost, structural strength and long life.

Picture shows backfill material being spread in trench for compacting to spring line of 69-in. reinforced concrete pipe on Provo River project near Provo, Utah. The concrete in the project includes 10½ miles of 69-in. pipe.

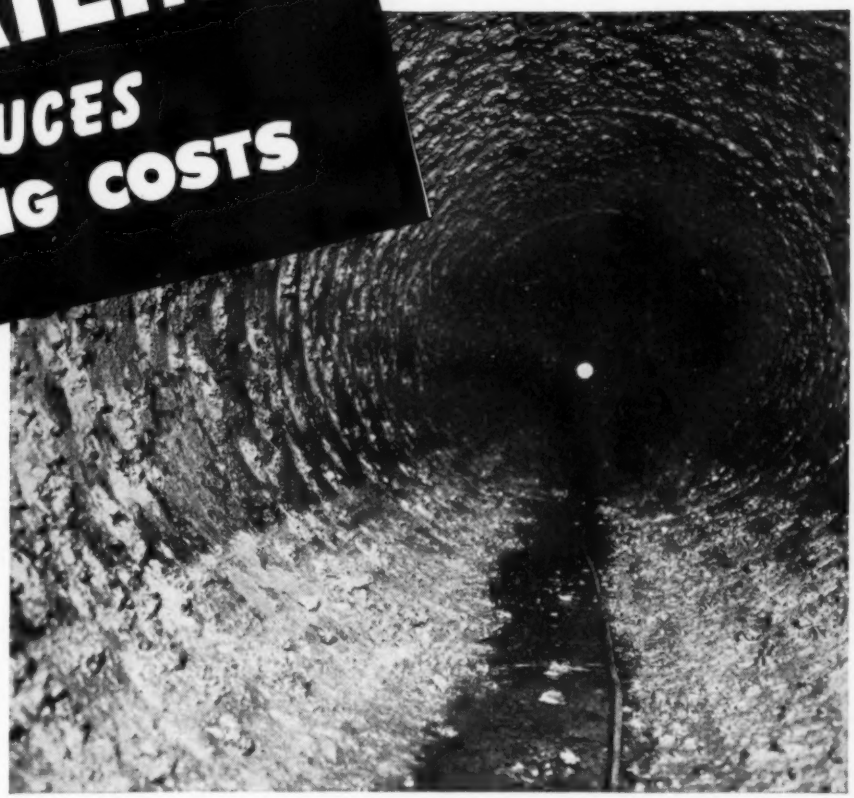
Water is carried 36 miles from the Deer Creek Impounding Reservoir to supplement the water supply of Salt Lake City and serve various irrigation needs.

AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

CENTRILINE REDUCES PUMPING COSTS

▶▶▶▶ WRITE TODAY FOR THE NEW CENTRILINE CATALOG

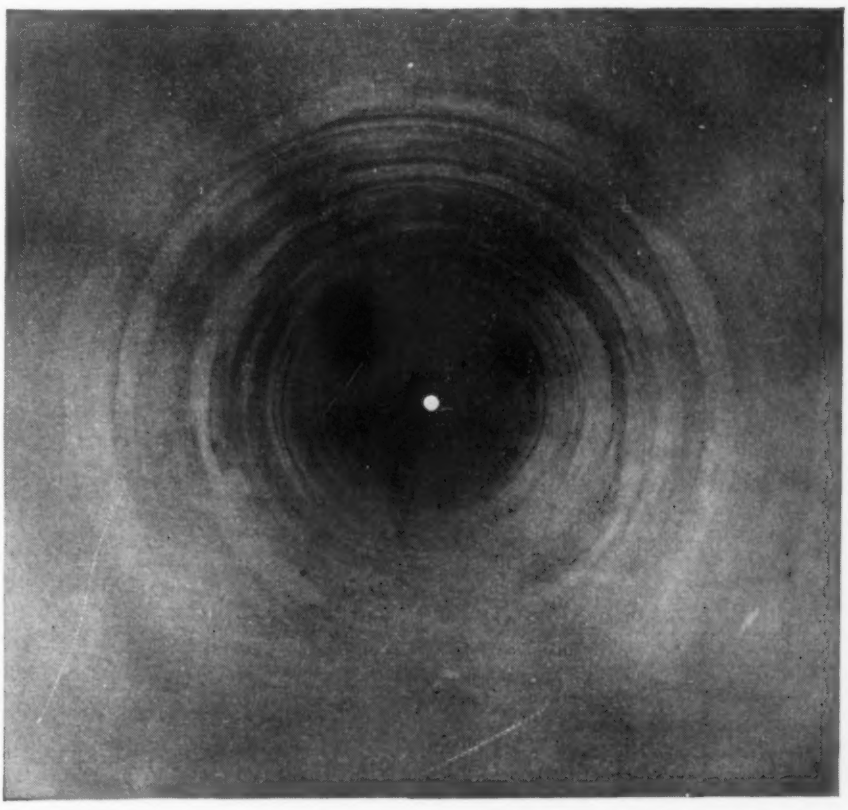


HIGH CARRYING CAPACITY means low pumping costs. Centriline, by assuring perpetually sustained high carrying capacity, keeps the pumping expenditure a low item on the community budget.

Protective cement mortar linings, as applied by Centriline, are continuous, dense, smooth, and without variation in quality. This ever-smooth surface permanently resists corrosion and tuberculation so that pumping expense and depreciation costs go down; coefficient of flow and useful life increases!

Whether old mains are losing efficiency or new projects are planned it is wise to consider Centrilining for the sake of the municipal budget. Our competent staff of hydraulic engineers is ready to assist you.

▶ PIPE LINING FACTS NO. 2 ◀



CENTRILINE CORPORATION

148 CEDAR STREET • NEW YORK 6, N.Y.

CEMENT MORTAR LININGS FOR WATER MAINS

Centrifugally Applied In Strict Conformity with A.W.W.A. Specifications

72 lbs. "SMALLER"

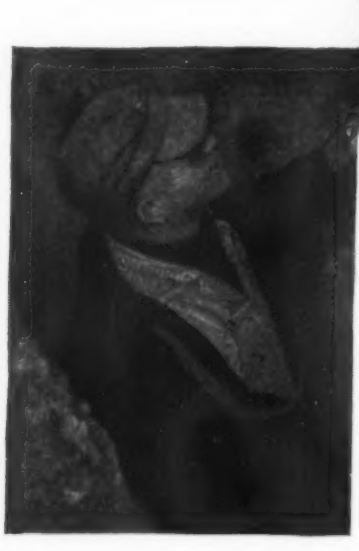
GRINNELL SOCKET FITTINGS

are easier to handle . . . cut installation time

● The 72 lb. weight advantage of this 8" Tee is typical of the space and time saving advantages of Grinnell's compact design in its complete line of socket fittings. See the table below for a tabulation of comparable sizes and weights of other popular sizes of Tees.

Socket and spigot dimensions and wall thickness are the same as AWWA Standard Class D pipe. Friction loss is not increased. Underwriters' Laboratories approved.

Write for catalog: "Water Works Specialties". Grinnell Company, Inc., Providence 1, R. I. Branch Warehouses in Principal Cities.



TEE

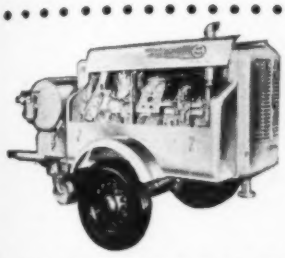
	Grinnell		Competition	
	Weight	Run from bell to bell	Weight	Run from bell to bell
4"	96 lbs.	11 in.	128 lbs.	22 in.
6"	147 lbs.	13½ in.	200 lbs.	24 in.
8"	222 lbs.	16 in.	294 lbs.	26 in.
10"	325 lbs.	19 in.	395 lbs.	28 in.
12"	417 lbs.	21½ in.	512 lbs.	30 in.

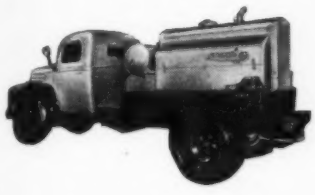
GRINNELL

FOUNDED 1850

WHENEVER PIPING IS INVOLVED

JAEGER Precision-Built Compressors





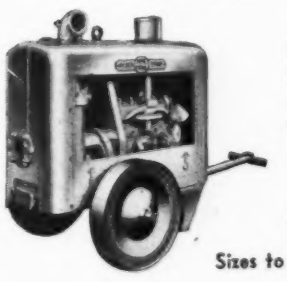
Built to the Micro-Precision Standards of Fine Engines in Balanced 2-Stage, Air-Cooled Units of 60 to 600 Cu. Ft. Capacity — Sold, Serviced in Over 120 Cities.

Buyers who know their air costs — in pounds of fuel for air delivered, in oil consumption, mechanical upkeep and long-term replacement — are today's big users of Jaeger "AIR PLUS" Compressors. Jaeger valves are 75% to 100% larger for free air flow and coolness and "ultra lapped" to positive, leak-proof closure. Balanced "W" type compressor operates at 20% to 30% slower, cooler piston speed (800 f.p.m.) is force feed lubricated. Intercooling is 100% efficient, provides automatic drainage.

Lifetime clutches, 30% to 50% larger air receivers, sectional radiators, bigger tool boxes, electric starters, grouped controls, Timken bearing wheels, etc., are all standard features.

JAEGER Enclosed-Type Pumps . . . . .

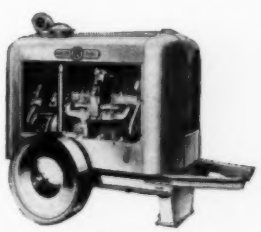
3,000 Gallon "Bantam"



Sizes to 10"

Jaeger developed and brought to peak efficiency the modern, compact, portable, self-priming centrifugal and now protects that efficiency by over-all enclosures which insure a dry, clean, quick-starting and smooth running unit under all weather conditions.

Doubly sure and fast priming action, extra power from bigger engines, high pressure shell construction of self-cleaning design, replaceable liners, longest-life seals and micrometer workmanship are Jaeger features. Every pump is factory tested and certified. Capacities up to 240,000 g.p.h.



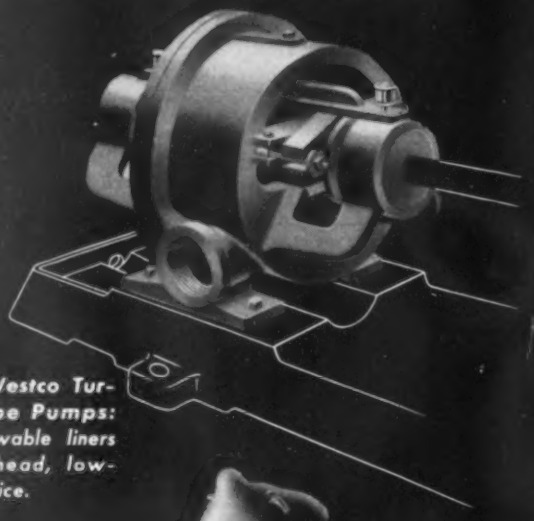
Self-Priming Jet Pumps, up to 250 lbs. pressure.

Leading distributors in over 120 cities sell, rent, service Jaeger Compressors, Pumps, Mixers, and other equipment. Send for Catalogs and name of your local Jaeger dealer.

THE JAEGER MACHINE COMPANY

Main Office and Factory, Columbus 16, Ohio—Regional Offices at

8 E. 48th Street, New York 17, N. Y.
226 N. La Salle St., Chicago 1, Ill.
235-8 Martin Bldg., Birmingham 1, Ala.



Famous Westco Turbine-Type Pumps: with renewable liners for high-head, low-speed service.

Fairbanks-Morse-Pomona Vertical Turbine Pumps: Open or closed impellers; oil or water lubricated.

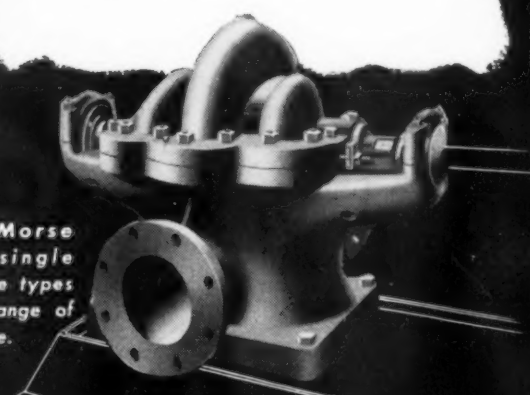
Can ANYONE sell a pump?

No, just anyone can't sell a pump —properly.

It takes a lot of adroit engineering to figure the right pump for any specific job. It takes a broad background of experience to enable a man to be sure he's selling you a pump that will make you a long-term friend and customer.

This engineering ability and experience are yours when you buy from a Fairbanks-Morse-Pomona dealer.

He *knows* pumps. He has the broadest line to choose from; he's backed by all the engineering and production resources of Fairbanks-Morse. *He* can offer you skilled, impartial advice—*he* can sell you the pumping savings and satisfaction you're after.



Fairbanks-Morse Centrifugals: single and multi-stage types for broadest range of pumping service.

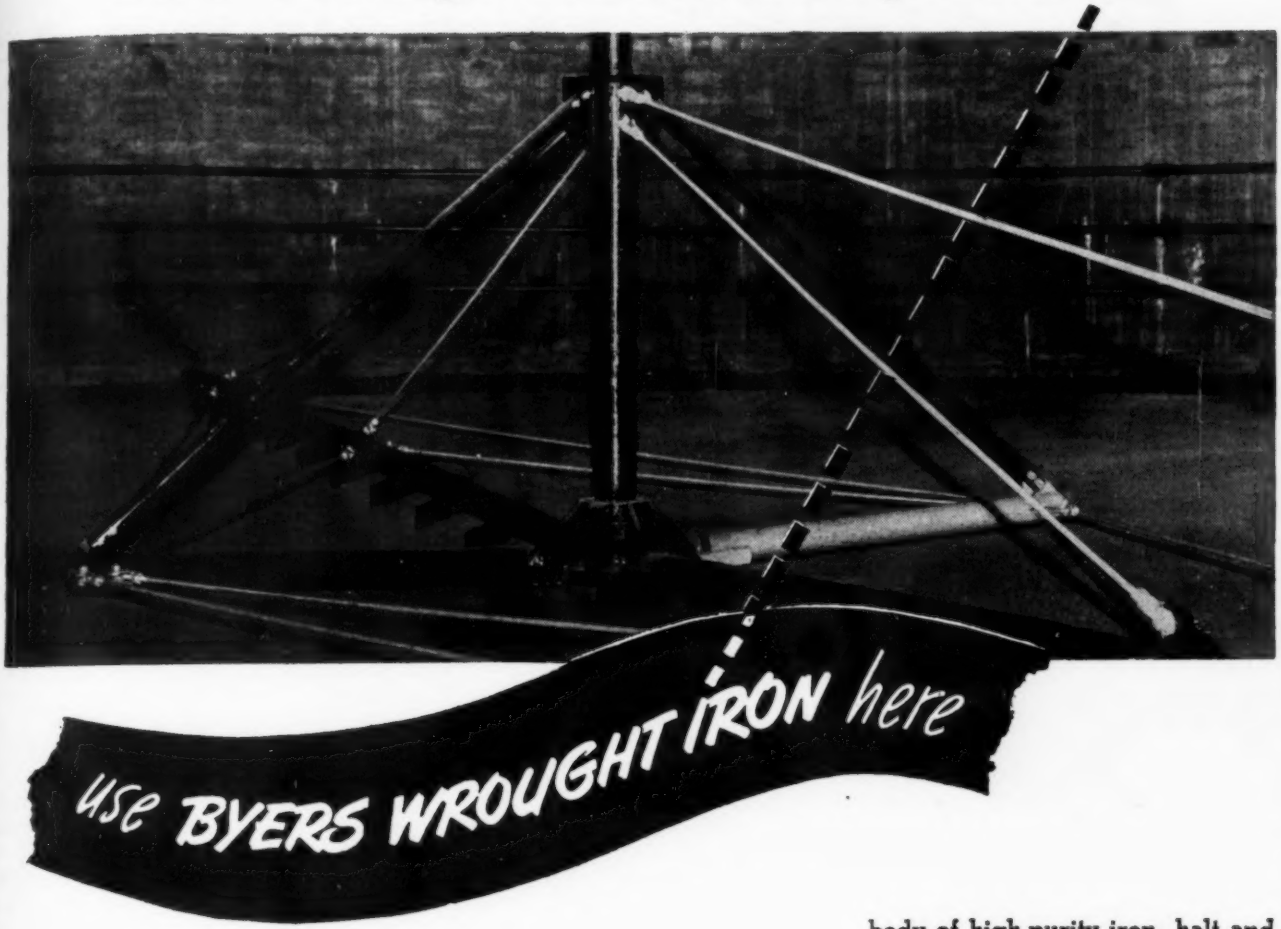
Fairbanks-Morse Rotaries: for low-head, low capacity work in all industries.

FAIRBANKS-MORSE

A name worth remembering

DIESEL LOCOMOTIVES · DIESEL ENGINES · PUMPS · SCALES · MOTORS · GENERATORS · STOKERS · RAILROAD MOTOR CARS and STANDPIPES · FARM EQUIPMENT · MAGNETOS

To avoid "Digestive Troubles" in new sewage treatment plants,



Sewage treatment plants are filled with corrosive services, but if you were going to pick the toughest one, it would probably be the sludge digestion tank. Here the normal aggressiveness of the sewage is increased by elevated temperatures, so that the heating coils face unusually severe conditions. The stirring mechanism has almost as great corrosive attack to contend with, and in addition is subjected to mechanical stresses and strains while operating.

Fortunately, you don't have to look far for an answer to the material problem. Byers Wrought Iron has given a splendid account of itself in heating coil applications, and some of the largest and most modern plants in the country use the material exclusively for this service. New York, Indiana, Massachusetts, Pennsylvania, Illinois, Texas and Rhode Island all have plants built within the past few years in which Byers Wrought Iron was selected for digestion tank heating coils by the engineers.

The service of wrought iron in heating coils would be enough to indicate its value for stirring mechanisms, but there is direct evidence available. One western municipality installed a mechanism made of ordinary materials when the plant was built. It failed in only one year. A new one, fabricated from Byers Wrought Iron bars, plates and angles was then installed. That was six years ago, and it is still serving, with no repairs or trouble.

Wrought iron's dependability stems directly from an unusual structure. Tiny fibers of glass-like silicate slag, threaded through a body of high-purity iron, halt and diffuse corrosive attack. They also anchor the initial protective film, which shields the underlying metal.

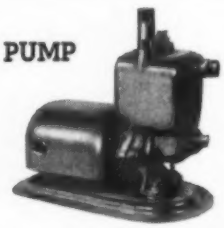
You will find some detailed information on wrought iron in sewage services in our bulletin, "Wrought Iron for sewage treatment and disposal installations," which will help you in planning any modernization or new construction. May we send you a copy?

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N. Y.

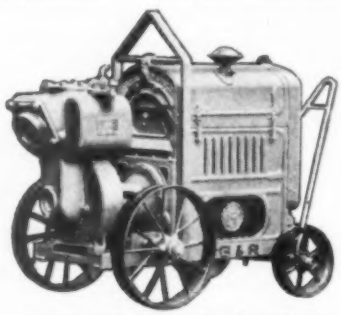
CORROSION COSTS YOU MORE THAN WROUGHT IRON

PUMPS — Engineered to Do the Job!

THE HANDY PUMP



Fitted with pipe or common garden hose, this pump will lift water up to 25 feet. Delivers 8 gal. per min. at 40 lbs. pressure. Electric motor driven — self priming — weighs only 20 lbs.

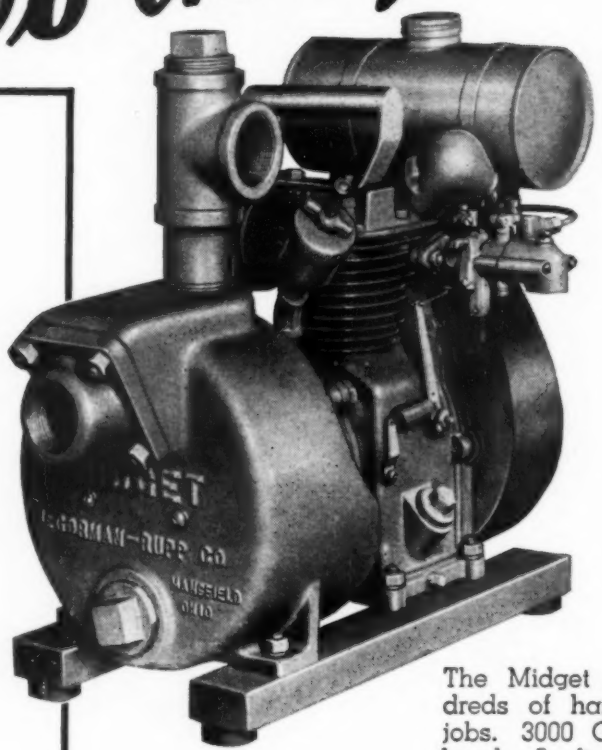


THE MODEL 1602 (90M)

Gorman-Rupp model 1602 will pump 90,000 GPH at average total head.

THE NEW ODORLESS SANITARY CLEANER (O. S. C.)

A modern apparatus for cleaning septic tanks, vaults and cisterns. Shipped complete ready to mount on standard truck chassis, 158 to 161 in. length. Septic tanks of 1000 gallon capacity cleaned in 20 minutes. Approved by public health officials. Write for bulletin 7-ST-11.



THE MIDGET

The Midget can do hundreds of handy pumping jobs. 3000 GPH at 20 ft. head, 5 ft. suction lift; and it weighs only 60 lbs.

Gorman-Rupps are the simplest, most rugged design of any self-priming centrifugal pump made. They are engineered to give the best performance possible under any and all conditions and to assure continuous trouble-free service for a long period of time.

Faster Priming — more efficient — just start the motor and you start the water without making any adjustments.

Will not clog — nothing to cause stoppages — no valves, vents or ports — no tubes — no orifices — no clean-out plates.

Whatever the size or application from 3000 GPH up to 25,000 GPH you can do the job more profitably with a dependable Gorman-Rupp Blue Pump.

Write for further information or contact your nearest distributor.

THE GORMAN-RUPP COMPANY

Gorman-Rupp Pumps — Unsurpassed for Pumping Fast

323 N. Bowman St. **Mansfield, Ohio**

Aqua Nuchar Activated Carbon is daily proving its versatility by removing tastes and odors normally occurring in surface water supplies all over the country. AQUA NUCHAR successfully controls by adsorption tastes and odors commonly characterized as earthy, woody, vegetable, bitter, aromatic, fishy, marshy, swampy, muddy, and chlorine; which may originate from decaying vegetation, algae, or industrial wastes. The amount of Aqua Nuchar required will depend upon local conditions, but records show that the average cost per person per year to insure palatable water is less than *two cents*.

Aqua Nuchar is stocked at convenient points throughout the United States . . . ready to serve you at a moment's notice should tastes and odors suddenly develop in your raw water supply. Write to our nearest sales office for the location of the Aqua Nuchar warehouse stocks most convenient to you.

industrial CHEMICAL SALES

division west virginia pulp and paper company

230 PARK AVENUE
NEW YORK 17, N. Y.

35 E. WACKER DRIVE
CHICAGO 1, ILLINOIS

748 PUBLIC LEDGER BLDG.
PHILADELPHIA 6, PA.

844 LEADER BLDG.
CLEVELAND 14, OHIO

Engineering Facts about TRANSITE PRESSURE PIPE

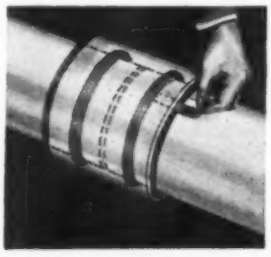
Subject:—JOINTS

THE SIMPLEX COUPLING—the standard coupling for Transite* Pressure Pipe—was engineered by Johns-Manville to minimize costly underground leakage and to provide maximum protection against pipe line failures resulting from trouble at the joints.

SIMPLICITY of the Simplex Coupling helps assure perfect joints independent of workmen's skill. These cutaway views show complete assembly operation: (1) Start, (2) Sleeve pulled over one ring, and (3) Final position with sleeve centered over joint.

It consists of only three parts: a Transite sleeve, carefully machined to fit over the end of the pipe, and two rubber rings which, when assembled, are tightly compressed between pipe and sleeve. The result is a tight yet flexible seal that provides a number of important advantages.

First, its effectiveness does not depend on the individual skill of the workmen. The Simplex Coupling is, in effect, a factory-made joint which is simply *assembled* on the job. Perfect joints are quickly, easily made, even by inexperienced crews. And—a unique feature—each joint may be checked for proper assembly immediately upon completion.

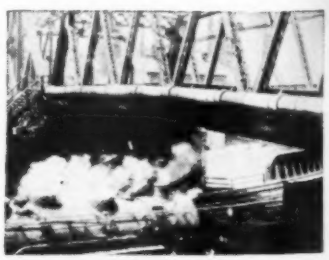


PROPER ASSEMBLY of each joint is readily checked by inserting a feeler gauge between sleeve and pipe. If position of the rubber rings is correct, the joint is properly made.

Moreover, the flexibility inherent in the design of this coupling safeguards against leakage once the pipe has been placed in service. Because each joint is capable of deflection, the entire line has a flexibility not commonly found in other types of underground water line construction. This minimizes flexural stresses in the line . . . enables the pipe to conform to soil movement . . . helps it absorb the vibration of heavy traffic under busy city streets. Many thousands of miles of Transite Pipe confirm the ability of the Simplex Coupling to protect the line against the stresses that so often cause joint leakage and frequently result in pipe failure.

DEFLECTIONS up to 5° at each joint are possible with the Simplex Coupling. This permits laying the pipe around curves or obstructions as shown by the installation above.

Joints that stay tight in service are but one of many important advantages of Transite—the modern asbestos-cement pipe that was engineered to carry water more efficiently and more economically. For further engineering facts, write for Brochure TR-11A. Address Johns-Manville, Box 290, New York 16, N.Y.



The flexibility inherent in the Simplex Coupling helps guard against the shock and vibration of traffic. Under busy city streets, this factor also minimizes flexural stresses.

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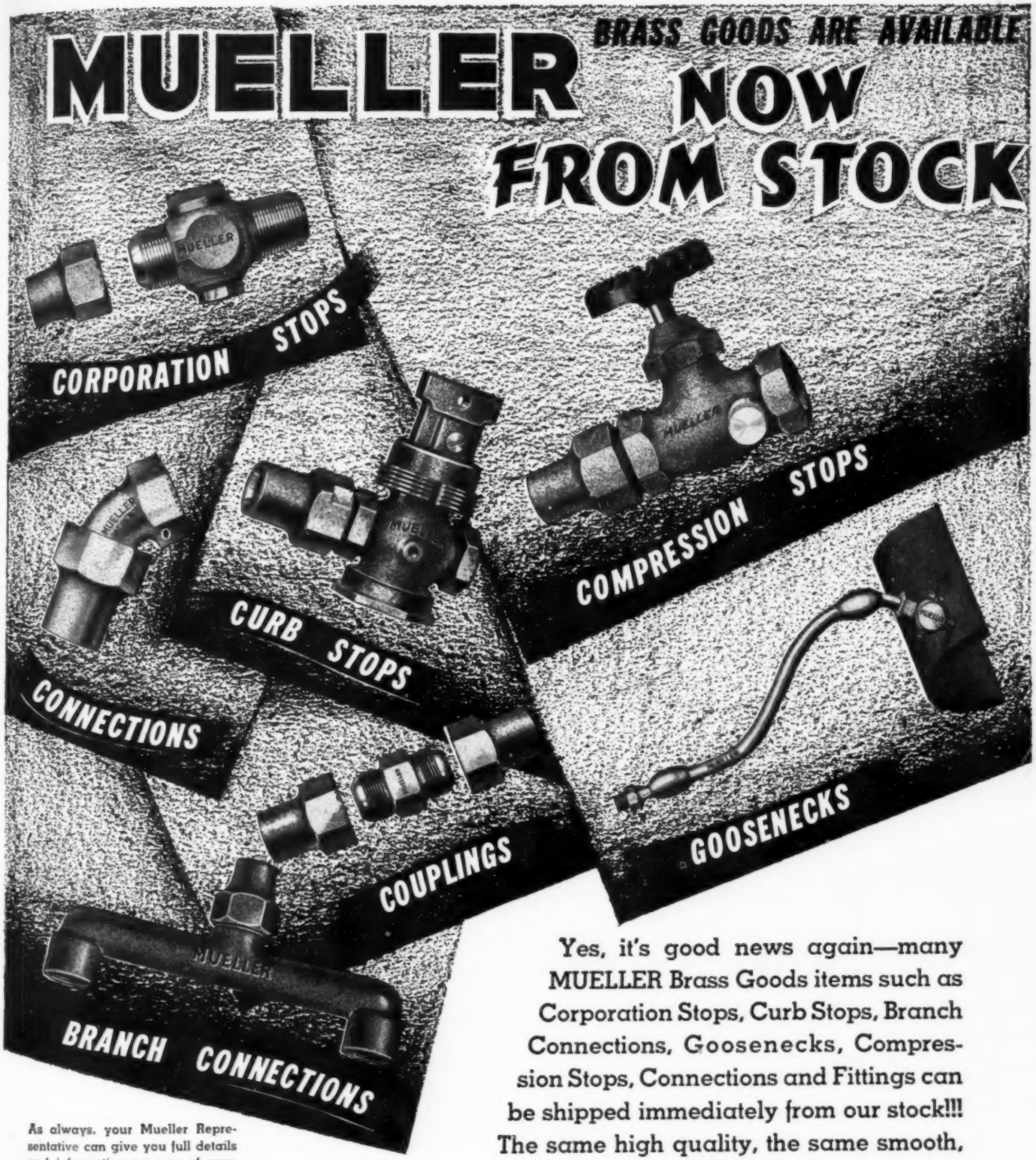

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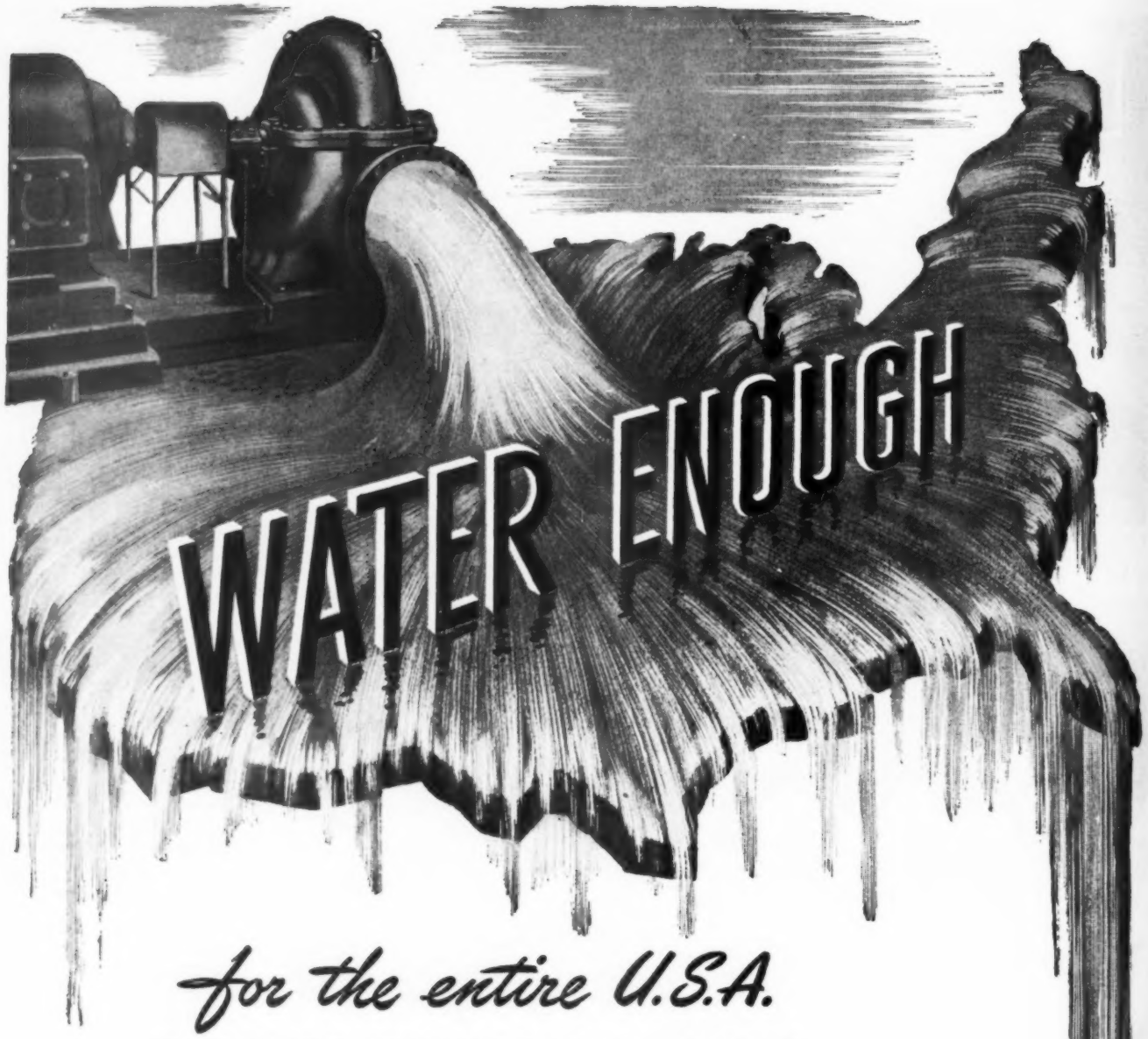

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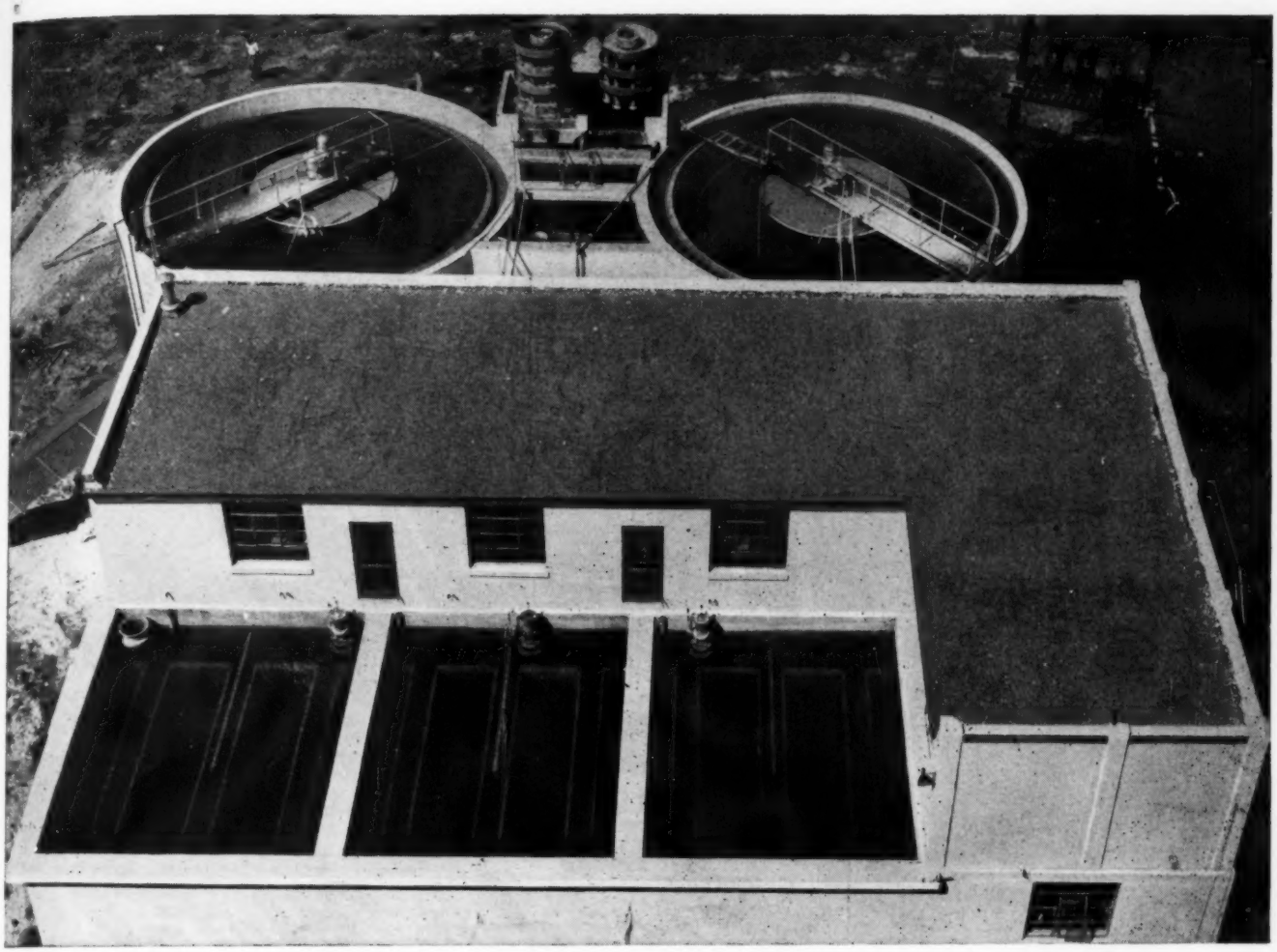

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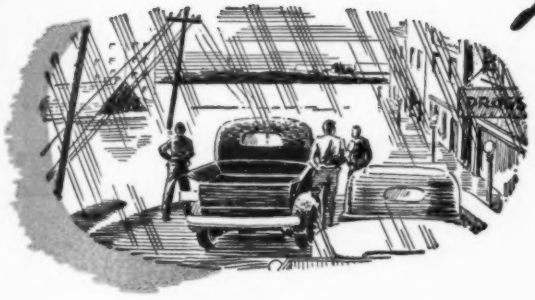

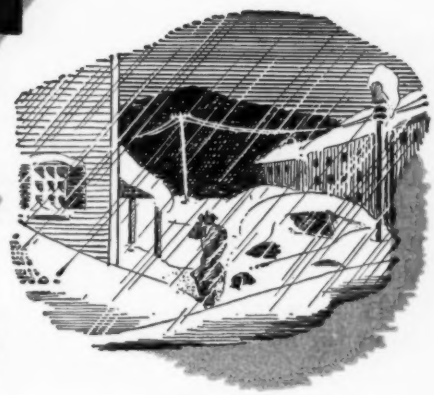

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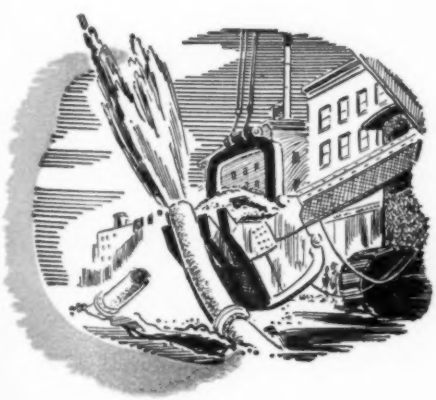

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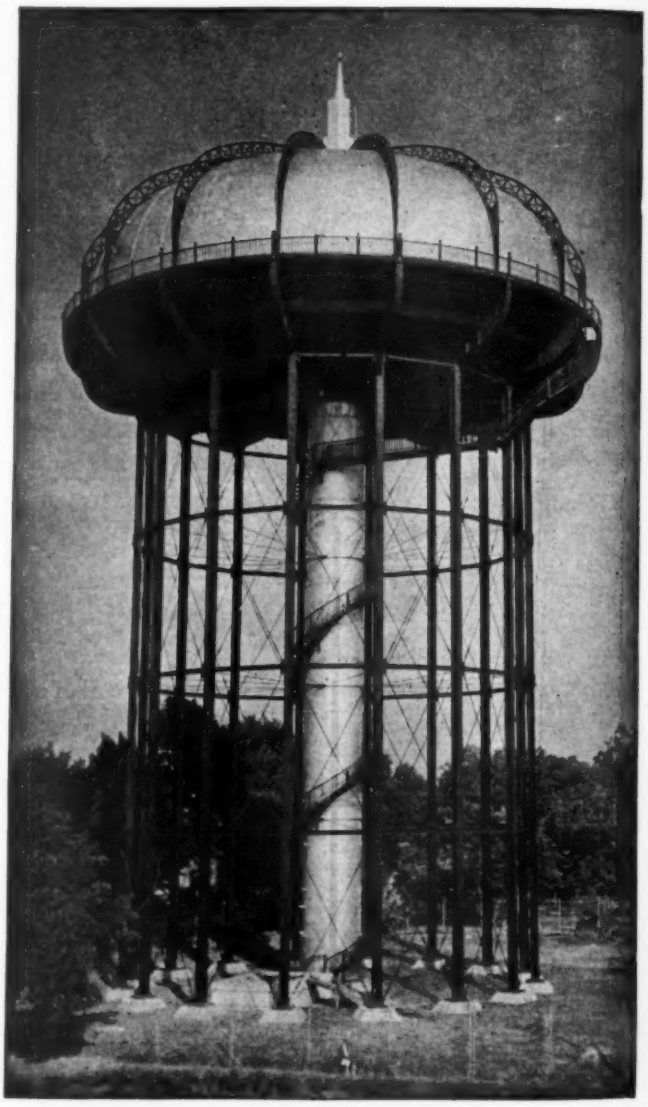

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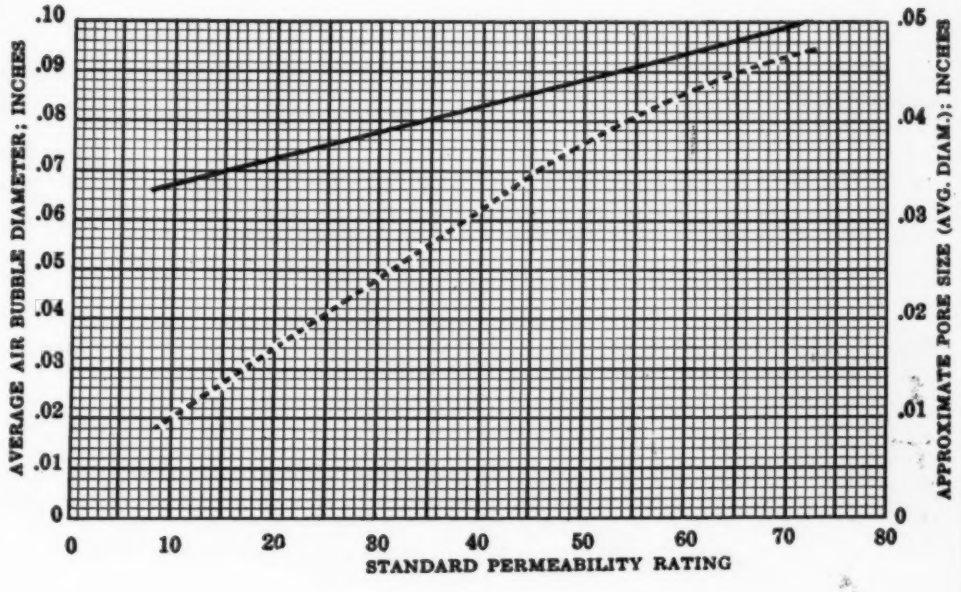

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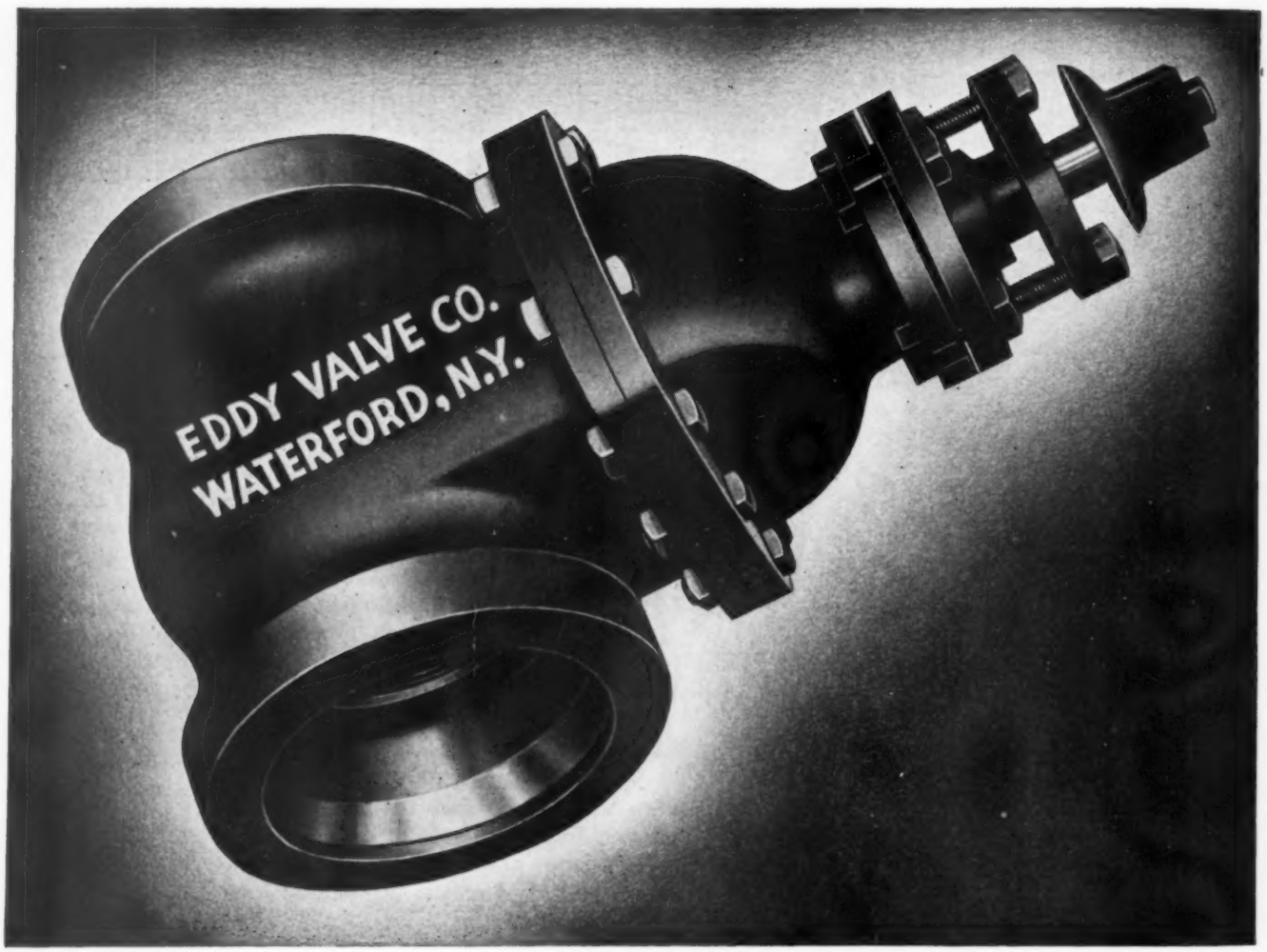

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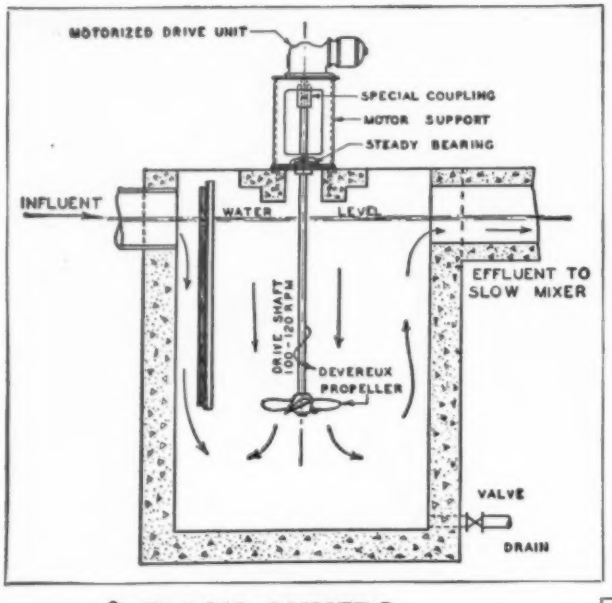

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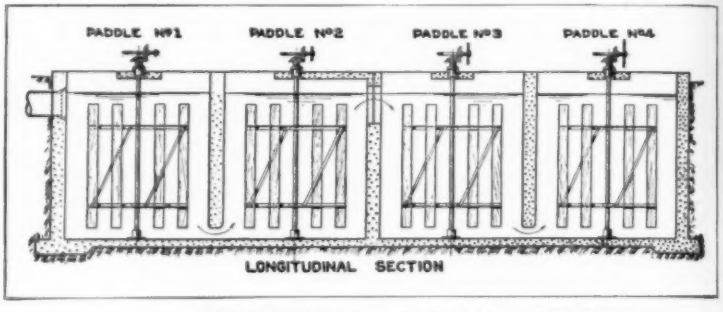

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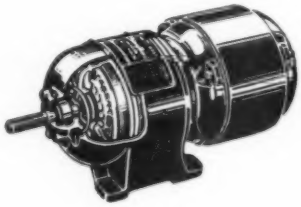

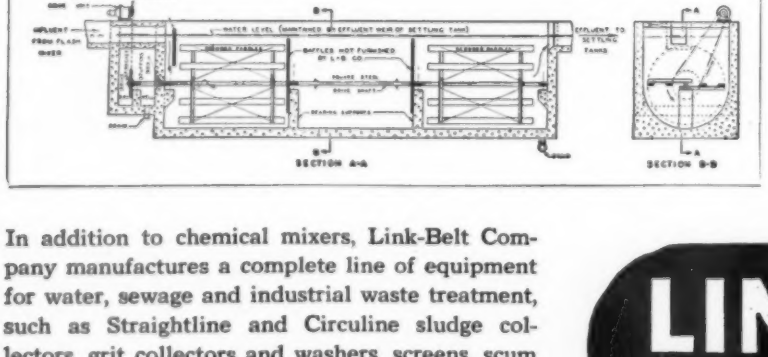

HORIZONTAL SLOW MIXERS

—for rectangular tanks where horizontal flow is desired. The degree of mixing can be reduced as the sewage flows through the tank by decreasing the number and changing the pitch of the paddles.

In addition to chemical mixers, Link-Belt Company manufactures a complete line of equipment for water, sewage and industrial waste treatment, such as Straightline and Circuline sludge collectors, grit collectors and washers, screens, scum breakers, aerators, dryers, power transmitting, elevating and conveying machinery. Send for catalogs. 10,744

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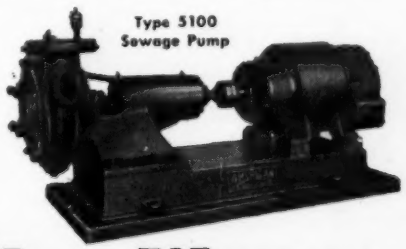
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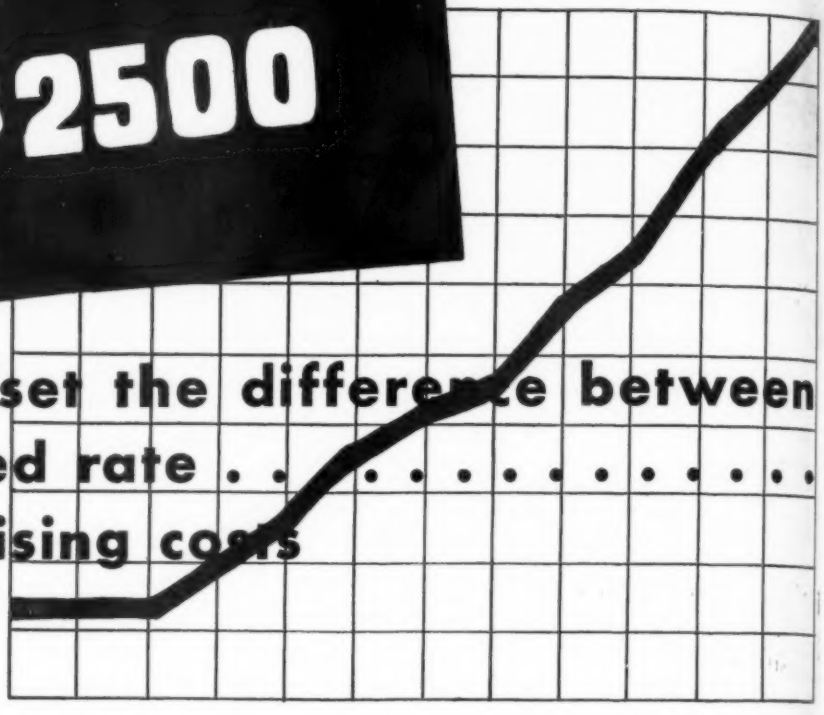

to offset the difference between a fixed rate . . . . . and rising costs

YOU can't always stop rising costs. You can't UP water rates, except as a last resort. But you can increase revenue by a systematic program of meter testing and repair.

Typical of a number of towns reporting results of a meter-testing program is the case of one small town, which increased revenue over $2500 a year, and at the same time reduced pumpage 2.2%!

Your town may be able to do as well – or better.

Today facts prove that more than 13% of the water used in the average home is used at about ¼ g.p.m. This shows the importance of having your repaired water meters register at least 90% at that rate of flow. Of unaccounted-for water, more is lost through under-registration of meters at low rates of flow than you may realize!

Your Trident representative will be glad to give you the benefit of his experience in connection with modern meter shop operation.

Trident Water Meters

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WATER & SEWAGE WORKS

VOL. 94, NO. 9 SEPTEMBER, 1947

A Gillette Publication

Adjusting Rate Structures to Rising Cost Levels*

By LOUIS R. HOWSON
Construction Engineer
ALVORD, BURDICK AND HOWSON
CHICAGO, ILL.

IN these days of universal and generally accepted higher prices, a demonstration of the necessity for increased revenues for water works is possibly superfluous. Some general indication or comparison may be helpful, however.

Water is both a commodity and a transportation service. The revenues necessary to support water works therefore may be reflected to some degree in the price level structures of commodities and of transportation services.

As a commodity, water is most important. Fig. 1 indicates its importance as measured in the annual tonnage produced, compared with coal, steel, wheat and cement. The tonnage of water delivered to American distribution systems in a year is 2½ times the tonnage of all the coal mined in the United States. It is approximately 20 times the tonnage produced by all the steel mills in the country in their banner year. It is 60 times the tonnage of wheat grown in a billion-bushel crop year.

As measured by the cost of the commodities on a tonnage basis, water sells on a countrywide average of about 4c per ton delivered. Coal in 1944 averaged $3.18 per ton, f.o.b. mines; the average price for all steel is approximately $60 per ton; and wheat at present prices more than $60 per ton. Water is the commodity greatest in tonnage and lowest in price (Fig. 2).

As a transportation system the waterworks of the United States transport over 1,800,000,000 tons of water per year, or 60 per cent as much tonnage as all of the railroads of the United States. The average revenue from this transportation service by the water works (Fig. 3), is approximately 0.3c per ton-mile, in contrast to the 0.95c charge per ton-mile of American railroad freight transportation. The water works revenue also includes the cost of the commodity transported, whereas the railroad revenue does not.

The Author

Commodity Price Changes

In 1947 water is generally selling at the same price as in 1940, whereas coal, wheat, sugar and other basic commodities have increased in cost from 50 to 100 per cent or more.

Reference to commodity indexes discloses that (Fig. 4):

1. Wholesale prices increased by 60 per cent in the period from before Pearl Harbor to May 1947 (source: U.S. Labor Bureau).

2. The cost of living index increased 55 per cent (U.S. Labor Bureau—1935-39 = 100).

3. Retail prices increased 52 per cent (U.S. Commerce Dept.—1935-39 = 100).

4. Factory wages, which are reflected in the cost of commodities, increased 50 per cent (U.S. Labor Bureau).

It is apparent from these figures that commodities other than water have increased in cost as a general average approximately 50 per cent since the beginning of the war, whereas the cost of water has remained substantially static.

Transportation Cost Changes

Recently the Interstate Commerce Commission granted the railroads a 17.6 per cent increase in freight rates. Minor increases on certain classifications had previously been allowed. There is now pending application for additional increase of 15 to 25 per cent in freight rates, which it is claimed will only compensate the carriers for cost increases prior to 1947. A general increase of 10 per cent in interstate passenger fares has also been approved and placed in effect. These increases were found necessary for the railroads even though in 1945 the railroad revenues were more than 100 per cent above those of 1940. Water works revenues increased but 20 per cent in the same period. Substantially all water works are operating at the same rates as before the war.

Effect of War on Water Works

In an effort to ascertain the relationship between water works revenues and operating expenses from 1941 through 1946, the operating statistics of approximately 100 water works have been studied. These systems supply approximately 9,000,000 people, or more than 10 per cent of the population in the United States that is served by public water sup-

*A paper presented at the 1947 San Francisco Conference of the Am. W. W. Assn. and here published by permission of the Association.

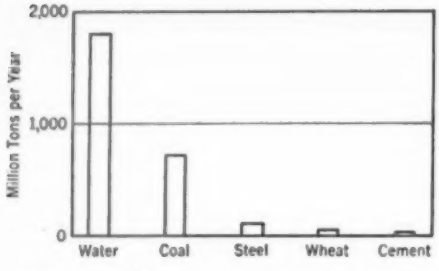

Fig. 1. Weight of Annual Commodity Production

plies. A condensed statement of the revenues, operating expenses (excluding taxes and depreciation) and revenues less operating expenses of these utilities, and of the relation of their operating expenses to revenues, is shown in Table I. The latter relationship is also plotted in Fig. 5.

prices for both materials and labor were rising rapidly, there was more normal maintenance of facilities, and the operating ratio of expense to revenue increased 3 points, or nearly 6 per cent, in a single year. Although in 1946 the revenues exceeded the 6-year average by more than $5,000,000 per year, the excess of revenues over operating expenses in 1946 was but $400,000 more than the 6-year average. A 10 per cent increase in revenue was almost entirely absorbed by the increased cost of labor and materials. The water works systems have become engulfed in the "profitless prosperity" to which some industries have been subjected.

In the 20-year period from 1925 to 1945, the ratio of operating expenses to revenues increased 6 points. In the single year from 1945 to 1946 this ratio increased 3 points, or one-half as much as in the previous 20 years. Net revenue is being drastically reduced at a time when there is a sharp increase in the cost of the items for which it has normally been expended.

Table I

REVENUES AND OPERATING EXPENSES OF 100 WATER WORKS

Year	Revenue	Operating Expenses	Revenues Less Expenses	Ratio of Expenses to Revenues
				per cent
1941	$45,301,240	$22,981,831	$22,319,409	50.7
1942	47,549,779	23,333,976	24,215,803	49.2
1943	49,725,967	24,830,284	24,895,683	49.8
1944	51,238,216	26,064,490	25,174,726	50.7
1945	51,594,197	26,423,884	25,170,308	51.3
1946	54,121,593	29,354,212	24,767,381	54.2
5-year increase, per cent	19.4	27.8	11.1	
1945-46 increase, per cent	4.9	11.1	—1.6	

It will be noticed that the immediate effect of our entrance into the war was a reduction in the percentage relationship between expenses and revenues, and that thereafter the percentage of revenues required for operations increased at a relatively constant rate through 1945. This initial reduction was in large part brought about by the war-created shortages of labor and maintenance materials, which forced maintenance expenditures to be deferred. During the latter part of 1945, however, and all through 1946,

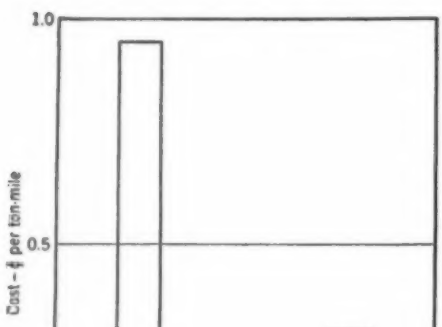

Fig. 3. Transportation Costs

In general, it is apparent that increased revenue is required by water works.

Amount of Increase Required

In a discussion of "Construction Costs and Water Rates" in 1946,[1] the author concluded that water works by and large would require at least a 20 per cent increase in rates above those of 1945 if they were to continue to furnish the same services and expand their facilities at the same rate as they had been doing in the past two decades.

It was also estimated that operating costs would increase "approximately 15.5 per cent within the very near future." For the 100 cities whose operations are summarized in Table I the operating costs increased 11.1 per cent for a 4.9 per cent increase in revenue from 1945 to 1946. There is still a lag in maintenance, and the figures for the calendar year do not accurately reflect the costs at the end of the year.

In the year since that paper was written, costs have increased much more rapidly than previously. When reviewed in the light of 1947 costs, an increase of approximately 30 per cent in gross revenues is found necessary. This figure is derived from the following calculation:

Gross revenue per customer (average of 100 water works 1945)	$32.10
Operating expenses before depreciation*	17.45
Net income before depreciation (per customer)	$14.65

*For 1945, but generally representative of prewar conditions because of restrictions on expenditures.

There have been two "national pattern" wage increases of about 17½ and 12½ per cent respectively, which, with correlated increases in fuel and maintenance materials, have increased or shortly will increase the prewar operating cost per customer about $4.70, reducing the estimated postwar net income from $14.65 to $9.95 per customer. This $9.95 obviously will not be sufficient to maintain and operate the properties and provide for their expansion, as the $14.65 has in the past.

From the prewar amount of $14.65 the water works normally spent about $7.35 per customer for new construction, leaving $7.30 to be spent for fixed charges, return on investment, and so on. On the assumption that at least this latter amount will be required for similar items in the future, the amount available for new construction out of the $9.95 will be reduced to $2.65 per customer. This $2.65, however, will not pur-

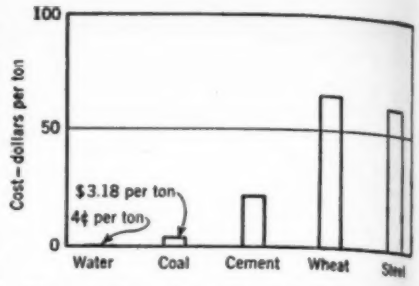

Fig. 2. Cost Per Ton of Commodities

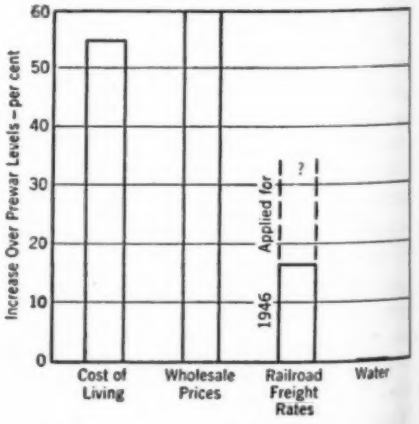

Fig. 4. Comparative Price Increases

chase as much construction as it would have in prewar days.

To provide the same construction facilities as cost $7.35 per customer under prewar conditions would now require the expenditure of $12 per customer. As the postwar net of $9.95 will only provide $2.65 per customer for new construction after meeting other costs, there will be a deficiency of $12 — $2.65 or $9.35 per customer. This $9.35 is 29.2 per cent of the 1945 gross revenue, which averaged $32.10 per customer. Rates must therefore be increased approximately 30 per cent if water works are to progress in the future as in the past.

Necessity for Progress

A water works is never static. For at least the past two decades construction expenditures have been increasing at a rate two and one-half times as fast as the growth in the number of customers. That growth must not be permitted to suffer because of failure to provide adequately for future financing requirements. Approximately 25 cents of every $1 of gross water works revenue has been expended for new construction. It is as much the obligation of water works management to provide the funds necessary for betterments as to maintain existing properties. Experience has shown that the best and cheapest water service is furnished from plants that finance ordinary improvements from earnings rather than bond issues. Financing in advance from earnings is approximately 40 per cent cheaper than through bond issues.

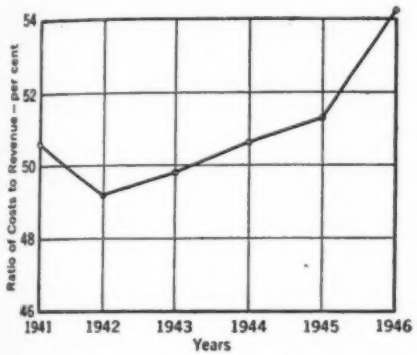

Fig. 5. Ratio of Operating Expenses to Revenues

As approximately 25 per cent of the water works revenue has been going for new construction in the past two decades, and as construction costs have greatly increased, it is obvious either that construction must be curtailed or that additional funds must be provided from revenues adequate to finance the equivalent amount of construction at present-day prices. It is important, therefore, to keep fully informed on the trend of construction costs.

Probably the most reliable index of such costs is that known as the *Engineering News-Record* construction cost index, the monthly figures for which, from 1913 to June 1947, are plotted in Fig. 6. Construction costs reflected in this index have increased more within the past year than in any other similar period in our history, except the year from June 1919 to June 1920. Following the June 1920 peak, the construction cost index recorded a 40 per cent drop in 20 months' time, a decline nearly twice as precipitous as that of 1931-33. A decline of such magnitude is not believed likely in the face of the present entrenched position of organized labor.

Water works rates necessarily have to operate in the future. Construction of new facilities is also a future operation. Accordingly, it is important not only to keep abreast of what has happened but to be as well informed as possible on what to expect in the future, so that construction work may be programmed for economical construction and water rate structures designed to provide funds for construction as needed.

The present price level situation is a combined result of World War II and a national labor policy. Similar effects have been observed after other wars and their postwar periods probably will be reflected to some extent in the years ahead. There is accordingly reproduced as Fig. 7 (extending so as to take in the data up to June 1947) a curve showing the effect of wars on construction cost and wage indexes.[1] On this figure are three lines, *A*, representing the Civil War, *B* for World War I, and *C* for World War II. Each line represents the relationship of either construction costs or labor indexes, at any time after the beginning of hostilities, to the cost level at the beginning of the war. From this figure it is apparent that the post-World War I period, in which there were no price restrictions, experienced widest fluctuations in construction costs, as indicated by the top line *B*. It is apparent that curve *C*, which represents World War II, is now at a point intermediate between the experiences of the Civil War and World War I. In both the Civil War and World War I, 13 years were required after the beginning of hostilities for the trough of the following depression to appear in the curve, and the lowest prices in both of those periods were approximately 50 per cent above their respective prewar levels.

We must be realistic. Pre-World War II construction price levels will never return. There will probably be some recession from present levels, however, as black markets in both labor and materials are dissipated by abundant supplies, as labor efficiency increases and as contingencies due to deliveries of materials and equipment disappear.

As of July 1947, the *Engineering News-Record* construction cost index stands at 406.5, referred to 1913 = 100. That is equivalent to 173 with 1939 considered as 100. The actual volume of construction, as measured by structures rather than dollars, is disappointing, and it would seem probable that a drop in construction costs will be necessary before construction will proceed to gain materially on the great backlog of demand that exists. Present conditions would appear to warrant the assumption that there will be some not-too-long-deferred downward adjustment of construction costs. Whether that will be accompanied by nothing more than a mild recession remains to be seen. Such adjustments usually swing too far (as was experienced in 1921-22), and then adjust to a normal level which will be on a new plateau for some time. It is believed expansion programs for the next decade should be based upon construction costs ranging from 60 to 75 per cent above those prevailing in 1939.

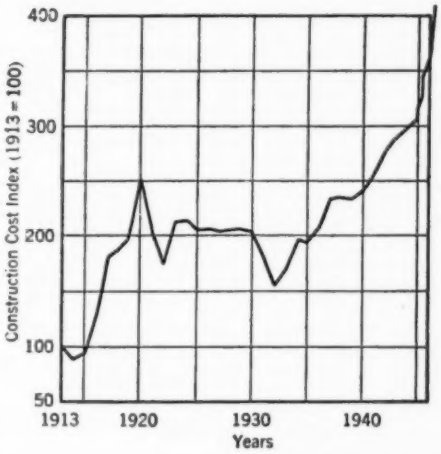

Fig. 6. E.N.R. Construction Cost Index

Source of Increased Revenues

A discussion such as this can only deal with a general pattern and cannot be specific. The need for increased water works revenues, however, is becoming relatively universal. The extent of the increase

required varies between wide limits, depending upon such factors as:

1. Whether the individual water works property has adequate facilities or must make large capital expenditures in the near future.
2. The adequacy of past revenues and whether or not funds have been accumulated to meet construction requirements.
3. The extent to which fixed charges, such as interest amortization and taxes, enter into the total revenue requirements.
4. How much deferred maintenance has accumulated.
5. The labor situation and cost in the community, as affected by industrial competition.
6. The rate of growth or expansion in facilities, and similarly related items.

It can only be stated that as a general, nationwide pattern it is believed that the water works systems, whether publicly or privately owned, will within the years immediately ahead need an increase in revenues of from 25 to 30 per cent if they are to continue the type of service and development which they have been providing in the past.

It must also be recognized that every rate schedule is a combination of strict equity and expediency, and that, within reasonable limits, that schedule of rates is best which, with reasonable equity between classes of customers, distributes the total cost of water service over all users with a minimum of customer resistance.

A good rate schedule discourages waste and provides every customer with the water he needs at a price which is within his means and which bears his equitable proportion of the total cost of water service.

A factor which should receive consideration when an increase in rates is contemplated is that any increase, even though generally expected, creates discussion. Thus it is better to make a rate increase sufficiently large at this time, when public psychology is favorable, than to make repeated adjustments upward in the rate schedule. One method which has been used with satisfaction over a long period of years in one of the larger municipal plants of the country has been to have a base rate schedule which at all times produces somewhat more than the requirements of the water works for operation and orderly expansion following a well developed program. To this rate schedule a variable percentage discount is applied. In years when the construction requirements were small, the discount was larger. In other years, when the construction program required larger expenditures, the discount was less. In this way, the customers understood that the changes were intended only to provide them with better facilities and better service, and there has been singularly little customer resistance.

If a water works, confronted with the necessity for increased revenue, currently has a rate schedule which distributes the total cost of water with reasonable equity over the various classes of customers, the procedure which will probably receive the most popular favor is the application of the same percentage increase to each class of customers. Application of this procedure, however, should only be made after carefully checking the cost of water to the largest users, in order to be sure that this percentage increase will not encourage them to leave the system and develop a separate supply—an action which might possibly raise still further the cost of water to the small users.

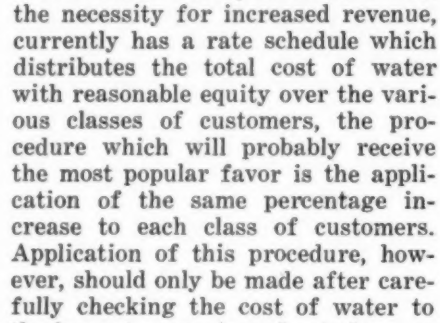

Fig. 7. Effect of Wars on Construction Cost and Wage Indexes

If the present rate schedule is unsatisfactory, it will probably be desirable to develop an entirely new one. This paper is not designed to present a complete discussion of rate schedules but rather to indicate a general or short-cut approach which can be used in determining procedure. The method will first be outlined and then applied to a hypothetical plant.

Patterns of Consumption

The first consideration, of course, is determination of the gross revenue reasonably to be anticipated as necessary to cover: (a) operating and maintenance expenses, including depreciation, (b) fixed charges, and (c) the average requirements for plant expansion.

In the development of a rate schedule, first consideration should be given to the small household customers as a group and to the few largest industrial customers—the two extremes of the schedule. In general, the greater proportion of the cost of water for small customers is derived from fixed charges and labor. For the largest customers the principal costs reflects the use of fuel power and chemicals.

In the normal city with the usual proportion of industries, the largest-consuming 1 per cent of the customers will use about 50 per cent of the water sold, and 40 to 50 per cent of the smallest residential customers will use less than 3,000 gal. per month each—in the aggregate but from 5 to 8 per cent of the water sold. Consideration of the two extremes of the rate schedule will therefore usually fix the cost of 50 to 60 per cent of the water to 40-50 per cent of the customers.

A detailed study of water rates involves a careful classification of customers. A more general classification of customers can be quickly made, however, following the procedure outlined by the study of water use in American cities made in 1916 by a committee of the New England Water Works Association, headed by the late Allen Hazen.[2] The study of classification of takers made in that report is reproduced herein as Fig. 8. It will be noted from this chart that in the average system of that date, 50 per cent of the customers used less than 100 gpd. each; 90 per cent used less than 400 gpd.; and an average of only 1 per cent used more than 4,000 gpd.

Since 1916 there has been a general increase in the use of water by residential customers, averaging approximately 1 gpd. per capita per year. At present probably 40 per cent of the domestic customers in the normal American city will use less than 100 gpd., or 3,000 gal. per month each.

Fig. 9 has been prepared to indicate the type of graph that can be developed quite readily by any water utility. It is plotted on logarithmic paper with the percentage of customers laid off along the horizontal scale and the daily consumption of water shown on the vertical scale. Point *A*, for illustration, is secured by counting the number of customers who pay minimum bills—assumed to cover consumption of up to 3,000 gal. of water per month. Their uses can be totaled to find the average amount of water used by each customer in this group. Point *B* at the other end of the diagram is plotted to show the use of the very large customers who constitute but 0.01 of 1 per cent of the total number. That, for illustration, would be the use of the fifth largest user in a plant hav-

ing 50,000 customers, or would be the use of the single largest customer in a plant having 10,000 customers.

Similarly, point *C* is plotted to show the use of the smallest of the 0.1 per cent of the largest users; in other words, in a plant with 50,000 customers it would represent the use of the fiftieth largest customer or, in a 10,000-customer plant, the use of the tenth largest customer.

Experience has shown that three points such as these determine with reasonable accuracy the pattern of the use of all customers of a given plant. When a curve is drawn through these three points and the data for intermediate uses is taken from it, the summation of all the customers' uses will usually check closely with the total water sales. As many intermediate points as may be desired or as are readily available from the customer classification in the particular plant may be plotted. The more that are plotted, the more detailed and accurate will be the analysis for that plant.

The Rate Structure

In order that the small residential users shall pay their equitable part of the total cost of water, it is necessary that the rate schedule provide either for a service charge or a minimum bill. Although a service charge is believed to be more equitable, the minimum charge is much more favorably received by the customers, and is used in about 80 per cent of American cities.[2]

The "minimum charge" should be such that it will include the "demand" or "readiness-to-serve charge" plus an allowance for the amount of water furnished under the minimum bill. The service charge part of the minimum should include the fixed charges—such as depreciation, interest and taxes on the investment—which must be met in order to have water available at all times at sufficient pressures to meet the demands—plus the cost of reading meters, billing, accounting and collecting. The "service charge" will usually amount to from 50c to 75c per month for a residential customer. To the "service charge" there should be added a sum to cover the cost of the quantity of water which is adequate for the average small household but which is not so low as to provide an incentive for skimping on necessary water uses. That amount is generally assumed to be approximately 3,000 gal. per month. Experience has shown that, if 3,000 gal. per month is allowed for in the minimum charge, the average minimum customer will use from 2,000 to 2,250 gal. or about 75 per cent of the permissible amount. At the average rate for all water sold, this amount of water will ordinarily amount to from 30c to 45c per month. When this usage cost is added to the service or demand charge, the total for a minimum bill usually falls within 75c to $1.25 per month. In this way the cost of water for approximately 50 per cent of the smallest customers is determined.

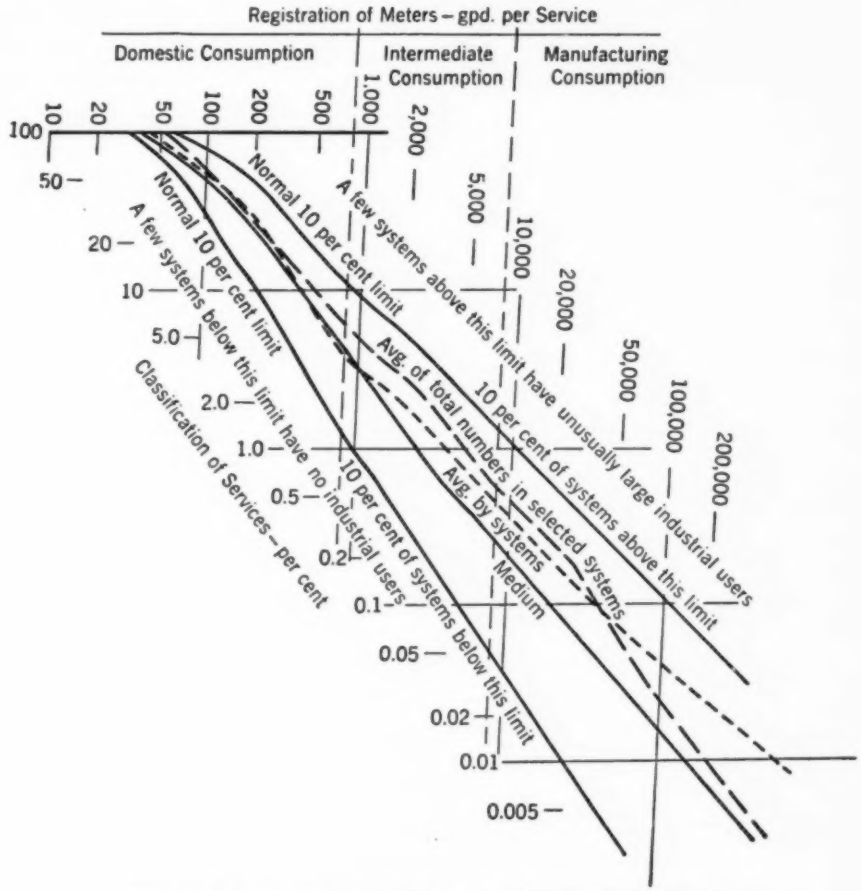

Fig. 8. Classification of Services by Consumption in 1916

The cost to the largest customers is usually figured on several bases:

1. If a plant is temporarily overbuilt and has surplus water available, it may for a time sell that surplus to a large customer at its "incremental cost." This amount is computed by comparing the cost of operating with the new customer in the system with the cost of operating without him. "Such incremental costs" primarily include fuel or power for pumping and chemicals for purification. No water works can afford to sell water at this rate indefinitely.

2. If the computation of water cost for the large user charges him with his proportionate share of the fixed charges on the investment in water works property, plus the added operating cost due to his service, the large user will still have a relatively low rate and the other customers will profit through his assumption of a part of the charges which would otherwise be borne by them.

3. If, in addition to the incremental addition to operating expenses and a proportionate share of the fixed charges, there is also included in the industrial user's rate a proportionate share of the cost of providing for future expansion and facilities, the cost to him will be raised somewhat, his total rate will still be materially below the average cost of water, and all of the other customers will benefit.

By such computations the cost of water for a large customer can be ascertained.

Having thus determined the two extremes of the new rate schedule—the industrial rate and the domestic rate—the fixing of the charges for uses of water intermediate between the two may be done usually in two or three steps of approximately equal cost spread.

Hypothetical Rate Structure

The above discussion may be illustrated by a concrete example, as shown in Table II.

Table II

COMPUTATIONS FOR HYPOTHETICAL RATE STRUCTURE*

	$ per year
Book cost of property	$10,000,000
Fixed charges	350,000
Taxes	150,000
Gross revenue from water sales	1,400,000
Fire protection charge	150,000
Operating expense, exclusive of depreciation and taxes	750,000
Net before depreciation and fixed charges	650,000
New capital requirements	300,000

*Utility serving 50,000 customers in population of 200,000 with an average 25 mgd. of water.

indicated. This amount would allow a customer with a ⅝-in. meter to use 3,000 gal. per month.

The equivalent number of ⅝-in. meters is computed from the meters in service; the number of each size larger than ⅝ in. is multiplied by a factor that recognizes the larger demand which such meters can exert. In this hypothetical plant the computation is as shown in Table IV.

The average revenue from all water sales is 15.3c per 1,000 gal.

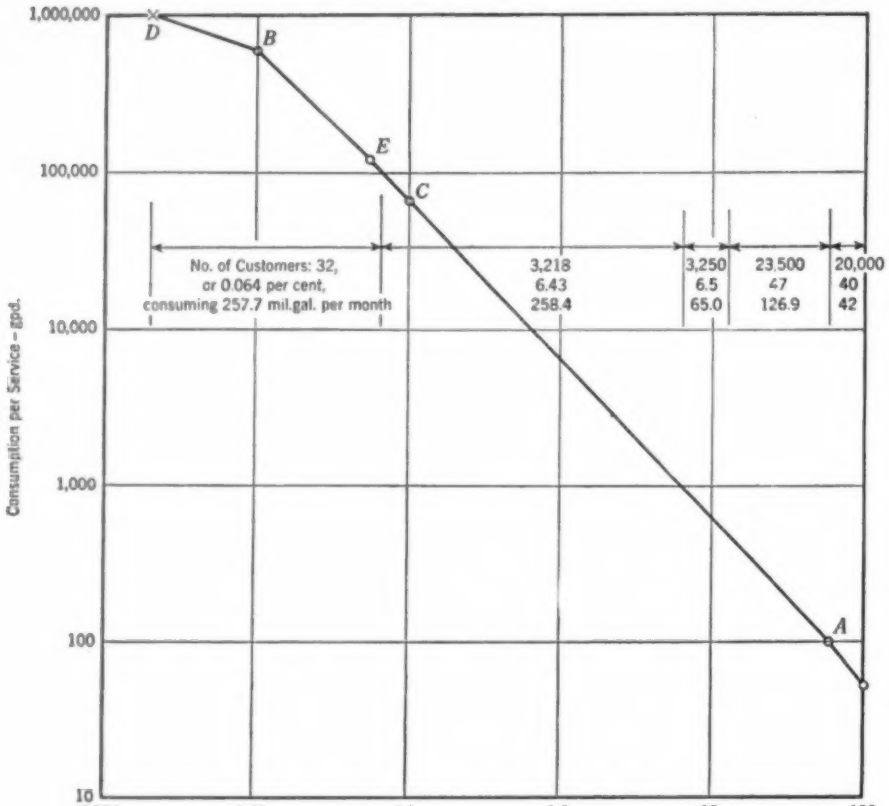

Fig. 9. Present-Day Classification of Services by Consumption

The customers have been classified as indicated on Fig. 9. The largest user of the 50,000 takes 1 mgd., as indicated by point *D*. The fifth largest user takes 600,000 gpd., as indicated on the diagram by point *B*. The five largest users take a total of 4 mgd. The fifty largest users take from 62,000 to 1,000,000 gpd. each. Their total use is approximately 9.4 mgd., or an average of 120,000 gpd. each, as indicated by point *E* on Fig. 9.

There are 20,000 minimum bills which have a permissible use of 3,000 gal. per month each. Their average use is 2,100 gal. per month, or 70 gpd. The minimum bill under this set of conditions may be determined as shown in Table III, in which a minimum bill of $1.25 per month is

The operating cost is 8¾c per 1,000 gal., exclusive of depreciation and taxes, and 11c per 1,000 gal. with depreciation and taxes included.

Table III

COMPUTATION OF ANNUAL MINIMUM COST

Readiness-to-Serve Costs	$ per year	
Fixed charges	$350,000	
Depreciation	100,000	
Taxes	150,000	
	$600,000	
	63,375*	= $ 9.45
Operation and Maintenance Costs		
Cost of services		0.75
Cost of meters		0.70
Meter reading, billing and accounting		1.75
Water used†		2.31
Total minimum cost per year		$14.96

*The equivalent number of ⅝-in. services.
†2,100 gal. at an average cost of 11c per 1,000 gal.

Charge for Large Customers

Analysis of the operating costs for supply, distribution, purification and general and administrative costs will show that such items as fuel, power and chemical costs are affected directly by the pumpage. Certain other costs, such as those for labor in pumping and purification, are affected but slightly—varying 10 per cent, more or less—and still other costs, such as those of administration, are not affected at all. In this hypothetical water works, analysis discloses that if a large customer is added, the increase in operating expenses necessary to provide for his requirements would be about 25 per cent as much per million gallons as the average before he took service. The "incremental cost" of water

Table IV

REDUCTION OF VARIOUS METERS TO EQUIVALENT AMOUNTS OF ⅝-IN. METERS

Meter Size, in.	No. in Service	Demand Factor	Equivalent No. of ⅝-in. Meters
⅝	46,400	1.0	46,400
¾	1,150	1.5	1,725
1	1,250	2.5	3,750
1½	450	5.0	2,250
2	500	8.0	4,000
3	100	15.0	1,500
4	50	25.0	1,250
6	50	50.0	2,500
Total			63,375

would therefore be 25 per cent of 8¼c, or 2.06c per 1,000 gal. If a water works had a large surplus, a rate as low as 2.06c per 1,000 gal. might be offered *for a short period* without increasing the cost of water to the present customers.

Each long-term customer must contribute his proportion of fixed charges. If the large customer were to bear his proportionate part of the fixed charges plus the additional cost of operation imposed by his service, there would be added to this 2.06c per 1,000 gal. the proportionate share of fixed charges, amounting to 3.83c per 1,000 gal. ($350,000 ÷ [25 mgd. × 365]), or 5.89c per 1,000 gal. The only advantage of this rate to the present customers would be a slight temporary reduction in their share of the fixed charges, which constitute about 25 per cent of their total cost of water. This rate would also be inequitable for a long term.

If, in addition to carrying a proportionate share of the fixed charges and the added cost of operation, the large user was to carry a proportionate share of the new capital requirement of $300,000 per year, his cost of water would be 2.06c for incremental operating cost plus 3.83c for fixed charges plus 3.27c for additions, or a total of 9.16c per 1,000

gal. He would be an attractive customer at that rate.

Instead of paying a proportionate part of new capital requirements, however, if the large user was to pay 1 per cent for depreciation, his cost would be 6.99c per 1,000 gal. It would appear that this last figure of approximately 7c per 1,000 gal. would be fairest.

Intermediate Rates

We now have determined the two ends of the rate schedule: (a) the minimum charge of $1.25 per month, which allows for 3,000 gal. of use, and (b) the very large industrial rate at 7c. The total revenue requirements are approximately $120,000 per month ($1,400,000 per year) from water sales.

The 20,000 minimum bills will produce $25,000 per month. If the industrial rate only applies to those using over 3 mil. gal. per month, reference to Fig. 9 would indicate that the total consumption in that step would amount to approximately 258 mil. gal., which at 7c per 1,000 gallons would produce $18,000 per month. The remaining $77,000 per month must be secured from water sold to customers in the other steps of the schedule. Since the total sales at the 25 mgd. rate total 750 mil. gal. per month, the consumption in the intermediate brackets is 450 mil. gal.

It is now practicable by a "cut-and-try" method to develop the intermediate steps in the rate schedule. The first step above the minimum should include practically all residential users, which means about 90 per cent of all consumers. Reference to the diagram again will indicate that 87 per cent of the customers use less than 15,000 gal. per month. It is estimated from the curve that the total use of those above the minimum but below 15,000 gal. per month will be 127 mil. gal.

The next bracket should take in the commercial and small manufacturing users, who ordinarily require from 15,000 to 30,000 gal. per month. Reference to the curve would indicate that there are 3,250 customers in this bracket and that their consumption approximates 65 mil. gal. per month.

The next bracket should include all except the very few largest customers. It is therefore made to cover all uses from 30,000 to 3 mil. gal. per month and is found to include 3,218 customers. Only 32 customers would use more water than this. The total use of water by customers in the 30,000- to 3,000,000-gal. bracket is estimated from the curve to be 258 mil. gal. per month.

The use of the 32 customers using more than 3 mil. gal. per month has already been computed as 257.7 mil. gal. per month.

It is found that if the cost of water for the three brackets is 24, 16 and 10c, respectively, with 7c for the few very large customers, the required amount of revenue will be produced as shown in Table V. The cost of various quantities of water under this schedule of rates is shown diagrammatically on Fig. 10.

Rate Increases Made

Some water works have already raised rates. Syracuse, N. Y., has adopted a straight percentage increase on all steps of the rate schedule. All rates including the minimum were increased approximately 50 per cent on Jan. 1, 1947.

St. Paul, Minn., has instituted a raise with a complete rearrangement of steps and revised relationship between charges to small and large customers, on the basis of a study by A.W.W.A. Past-President Leonard Thompson. The average increase from the new schedule, effective Feb. 1, 1947, is approximately 25 per cent, ranging from 10 per cent for small customers to 40-45 per cent for large commercial and industrial users, who had previously been offered a very low rate in order to compete with the readily available individual well supplies. Mr. Thompson advises that the public reaction has been practically negligible.

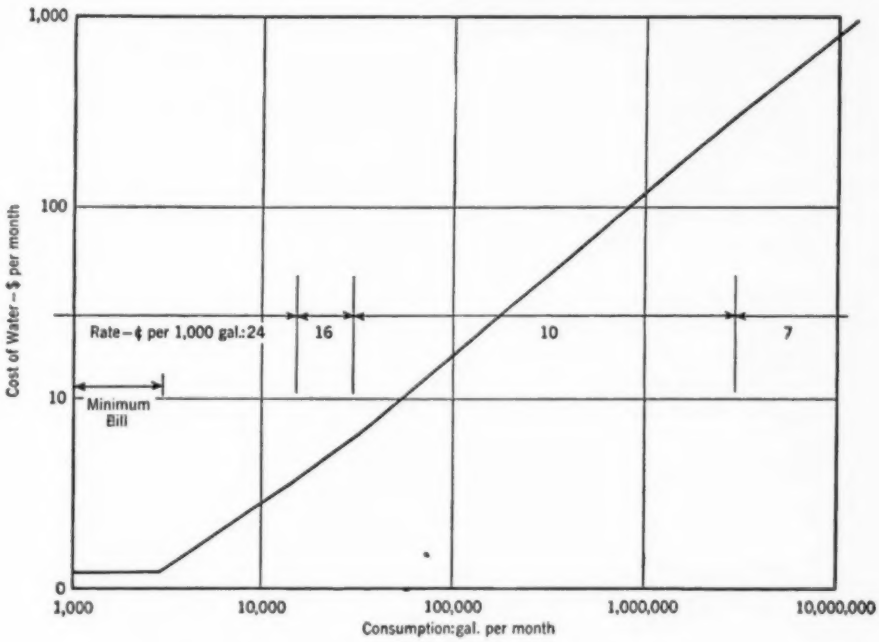

Fig. 10. Cost of Water to Various Customers

Table V
FINAL FORM OF RATE STRUCTURE

Step in Schedule	No. of Customers	Rate per 1,000 gal.	Monthly Consumption	Monthly Revenue
gal. per month		$ per month	mil. gal.	
Minimum bill	20,000	1.25	42.0	$ 25,000
First 15,000	23,500	0.24	126.9	30,456
Next 15,000	3,250	0.16	65.0	14,300
Next 2,970,000	3,218	0.10	258.4	35,115
Over 3,000,000	32	0.07	257.7	19,927
Total	50,000		750.0	$124,798
Less 5 per cent prompt payment discount on bills above minimum				4,990
Monthly revenue				$119,808
Annual revenue				$1,437,600

Municipal water works in most states set their own rates, and the responsibility is theirs to see that revenues are adequate. In a few states municipal rates are regulated, and in practically all states privately owned utility rates are regulated by Public Utility Commissions. For those water works application for change in rates must be filed with the commission, which usually holds hearings and takes from a few weeks to several months to reach a decision. A long delay may cause irreparable damage, and it is hoped that in times such as these the commissions will not require lengthy

valuation hearings but will at least grant temporary or interim increases based upon a proper showing of necessity from comparative operating figures.

Summary

The following conclusions are believed generally applicable:

1. Most water works, whether publicly or privately owned, should have increased revenues within the near future, or their service and development must be curtailed.

2. Although each water works should be separately considered, the average increase required throughout the country should be approximately 30 per cent.

3. If the arrangement of the present rate schedule is satisfactory and equitable, the simplest change is the application of a uniform percentage increase to all users. With less satisfactory schedules, the change offers opportunity for study and removal of inequities.

4. There is no completely equitable rate schedule. Each is necessarily tempered with some expediency. A reasonably equitable schedule that is generally acceptable to the customers is better than a theoretically perfect schedule the customers will neither understand nor adopt.

Acknowledgments

The author expresses his appreciation to those who furnished data or reports from which it was possible to extract the summarized figures of operations for the 100 plants analyzed in this paper.

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Boyce Heads Michigan's Civil Engineering Dept.

Earnest Boyce, professor of municipal and sanitary engineering at the University of Michigan, has recently been appointed as chairman of the civil engineering department.

Prior to going to Michigan, Prof. Boyce served the Army in the office of Quartermaster General as water supply consultant and thereafter was senior engineer for the U. S. Public Health Service.

Prior to his war service, Prof. Boyce was professor of sanitary engineering at the University of Kansas and chief engineer of the division of sanitation for the Kansas State Board of Health.

S. C. Martin Joins F.S.W.A. Staff

On July 1, S. C. (Sandy) Martin, formerly Principal San. Eng. in the Sanitary Engineering Div. of the Illinois Dept. of Pub. Health, became Executive Assistant in the headquarters office of the Fed. of Sewage Works Associations.

A native of Ohio and a graduate in civil engineering from Ohio State with an M.S. in sanitary bacteriology in 1932, Martin also took additional graduate work at Iowa State College.

In 1936, Martin joined the engineering division of the Illinois State Health Dept. under C. W. Klassen. During the war he spent 3½ years in the Army Sanitary Corps.

As Executive Assistant, Martin will work on all aspects of management and administration of the Federation and will take over certain editorial duties in connection with the Sewage Works Journal. These duties will include the expansion of the Operators' Corner and the production of the abstract section.

The employment of Martin as Executive Assistant in the Federation offices makes possible the expansion of service to the members and is in anticipation of the production of the Journal on a monthly schedule. The continued growth of the Federation, both in member associations and in individual members, has warranted this expansion of office staff.

Clifford Fore Joins Illinois Cities Water Co.

To Work With Gen. Mgr. Fred Abbenseth

Clifford Fore has accepted the position of Asst. Gen. Mgr. of the Illinois Cities Water Co. In this capacity he will supervise not only

the Robinson, Ill., plant but also those of Tuscola, Palestine, and Lawrenceville.

Mr. Fore will work under Fred Abbenseth, Gen. Mgr. of the holdings. Mr. Abbenseth is a one-time asst. supt. of the Westchester Joint Water Works No. 1 at Mamaroneck, N. Y., and was in the Army Specialist Corps at the Keystone Ordnance Wks. during the war.

Mr. Fore, who resigned his position as superintendent of water and sewage at Carbondale, Ill., on Aug. 1, is well known throughout the state of Illinois and in the Illinois Section, both for his work in conducting short schools and for his long time service in the Illinois Section, of which he is a Past Chairman. In San Francisco at the AWWA Convention, Fore received the Fuller Award for the Illinois Section for his unselfish work in establishing single-handedly the defunct water supply of Royalton, Ill. Two years ago Mr. Fore was given charge of the sewage treatment works in Carbondale, as well as the water plant.

F. W. Crane Appointed Gen. Mgr. Buffalo Sewer Authority

On July 1 Frederick W. Crane became the third general manager since 1938 of the Buffalo Sewer Authority in Buffalo, N. Y. Mr. Crane replaces Francis J. Downing, who entered private practice.

Crane, a graduate civil engineer of Cornell University, has been city engineer of the Dept. of Pub. Works of Buffalo since January, 1946. Prior to that time, from June, 1938, to December, 1945, he was on the staff of the Buffalo Sewer Authority as structural engineer and assistant chief engineer. Prior to 1938, Mr. Crane was a plant examiner and structural engineer in the Bureau of Buildings of the City of Buffalo.

Mr. Crane is well acquainted with the plans and work of the Buffalo Sewer Authority as during his seven years with the Authority before becoming City Engineer, he had charge of structural design, specifications, and contracts for eighteen million dollars worth of storm and sewer construction, including all types of structures. Mr. Crane also worked with the laboratory in studies of industrial wastes during that period and he will be remembered by our readers as the co-author, with Dr. George E. Symons, Assoc. Editor of *Water and Sewage Works*, and former Chief Chemist at Buffalo, of a paper on the development of a formula for charging industry for waste treatment. This formula has since become known throughout the country as the Buffalo Formula and has been referred to many times in industrial waste studies throughout the country.

A.W.W.A.–F.S.W.A. HOLD CONCURRENT CONVENTIONS IN GOLDEN-GATE CITY

WITH the City of the Golden Gate offering visitors a sample of its very finest weather, the week of July 21-25 saw water

Presidents

(AWWA)	(FSWA)
Wendell R. LaDue	*Francis S. Friel*
Supt. & Engr.	*President*
Water & Sewerage	*Albright & Friel*
Akron, Ohio	*Philadelphia, Pa.*

and sewage works men and their ladies gathered from all over the country in San Francisco, Calif., for the first concurrent conventions ever held of the American Water Works Association and the Federation of Sewage Works Associations. Registration figures indicated the record combined attendance of 1955, of which 1426 were men and 529 their ladies. Manufacturers' representatives accounted for but 401 of the 1955 gross attendance, and except for about 600 from California, the remainder (1355) came from various points in the country—many on special trains from the East and Midwest.

Further statistics indicate that there were 60 papers and one motion picture on the program, two banquets, three dances, a gala night, and president's reception, as well as a tea, fashion show, lunch, bridge, and a special tour of San Francisco for the ladies.

Secretaries

(AWWA)	(FSWA)
Harry E. Jordan	*Homer W. Wisely*
New York	*Champaign, Ill.*

(Both born in the same Illinois small town)

The largest display of water works and sewage treatment equipment ever exhibited appeared on the convention floor of the auditorium. There were 102 exhibitors who filled 159 booths and the auditorium floor was not large enough to accommodate them all. Several exhibits had to be set up in the corridors on both sides.

Both organizations elected new officers and made a number of awards for outstanding services and papers. At its annual business luncheon the Water and Sewage Works Manufacturers' Association also elected new officers.

In addition to the scheduled program and entertainment, many of the visitors, particularly from other states, took sight-seeing tours, did Chinatown, and indulged in delightful meals of various types in the many unusual restaurants in San

Award Recipients

L. R. Howson	*E. L. Filby*
Consulting Engr.	*Consulting Engr.*
Chicago	*Kansas City*
(Goodell Prize)	*(Diven Medal)*

Francisco. Many got a special thrill riding San Francisco's unique cable-cars over the hill to Fisherman's Wharf, renowned for its seafood eating places. Others got a thrill out of merely riding the cable lines at every opportunity—most of us being just kids grown up when it comes to electric trains or cable-cars.

It is probably too early to fully appraise the success of a concurrent convention of this type. Without doubt from the standpoint of both the attendees and the manufacturers, the exhibits were far larger and better than could be hoped for at separate meetings. Naturally certain difficulties arose, many of which might be circumvented in any attempt of a similar meeting in the future. Comment ranged all the way from "never again" to "should be held every year." Other suggestions ranged from "holding such meetings once in five years" to "holding the two meetings contiguously," as is now being done in some of the state

Presidents-Elect

(AWWA)	(FSWA)
N. T. Veatch	*Geo. S. Russell*
Black & Veatch	*Russell & Axton*
Engrs.	*Engrs.*
Kansas City, Mo.	*St. Louis, Mo.*

organizations. Despite some criticism of detail and difficulties, no one can say that the meeting was not a success, and reflective judgment on this meeting will determine whether or not meetings of this type are feasible, practicable, and advantageous, and, if so, how frequently such meetings should be held.

A.W.W.A.'s New Officers

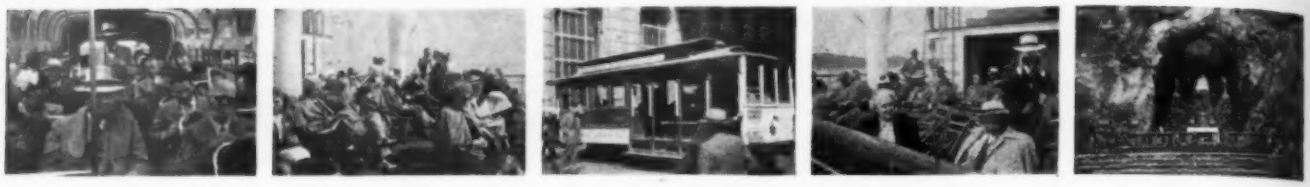
Following A.W.W.A.'s annual banquet which drew the 800 person seating capacity limit, **Wendell R. LaDue,** General Manager of Water and Sewerage at Akron, Ohio, and retiring president of A.W.W.A., presented the new officers as follows:

President, **N. T. Veatch,** Consulting Engr., Kansas City;

Vice-Pres., **Linn H. Enslow,** Editor, *Water & Sewage Works,* New York City;

Treasurer, **William W. Brush,** Editor, *Water Works Engineering,* New York City.

Honorary Member	Vice-Pres.
Malcolm Pirnie	*Linn H. Enslow*
Consulting Engr.	*Editor*
New York	*Water & Sew. Wks.*
(Past President)	*New York*



With the Water & Sewage Works Special Eastbound

To Bonneville Dam up Columbia Highway by bus; to Victoria Island, B. C., by steamer; a shrine in the Columbia Cliffs near Portland, Ore.; and a San Francisco cable-car gets turned around by its two-man crew at the Powell St. terminus.

A.W.W.A. Awards

As is the custom at the annual banquet, the retiring president presented the awards for the year.

Honorary Memberships went to Malcolm Pirnie, Consulting Engr., New York City (a past-president of the Association), and John Henry Cook, retired, of Paterson, N. J.

The **John M. Goodell** prize was presented to Louis R. Howson, Consulting Engr. of Chicago, for his paper titled "Guides and Checks in Water Works Operations."

The **John M. Diven Medal** was awarded to Ellsworth L. Filby, Consulting Engr. of the firm Black & Veatch in Kansas City, for his earlier work in A.W.W.A.; "Blue Print Now!" program; and more recently for his work on the study of public relations in water works, which was made, under his chairmanship, by A.W.W.A.'s special exploratory committee on this important matter.

Twenty-two **George W. Fuller Awards** were made to members of local sections for services to or in the section. Among those present to receive the awards were C. F. Wertz of Florida; Sheppard T. Powell, Four States Section; Clifford H. Fore, Illinois Section; Harry N. Lendall, New Jersey; John G. Copley, New York; L. J. Hoffman, Ohio, and G. B. Schunke, Pacific Northwest.

Other Fuller Awardees cited *en absentia* were C. G. Gillespie (Cal.); McHarvey McCrady (Canada); J. A. Cosculleula (Cuba); Leo Louis (Ind.); W. L. Harris (Mich.); McKean Maffit (N. C.); W. J. Moore (Pacific N. W.); W. V. Leonard (Rocky Mtn.); F. W. Chapman (Southeast); W. S. Mahlie (Southwest); R. W. Fitzgerald (Va.); J. C. Edwards (W. Va.); J. W. Myers, Jr. (Wis.).

Kansas and Cuban Sections Cup Winners

The Nicholas S. Hill Cup awarded that section showing largest per cent gain in membership during the year, was won by the new Kansas Section, with the second highest gain being recorded by the Southwest Section with its 55½ per cent member gain.

The Henshaw Cup, awarded that section holding the best attended meeting of the year, was won by the Cuban Section, with the North Carolina Section the runner-up.

Treasurers

(AWWA)	(FSWA)
W. W. Brush	*W. W. De Berard*
Editor	*City Engineer*
"Water Wks. Eng."	*Chicago*
New York	

(Water Works—Sewage Works, but how come both have the same initials—"W.W."?)

Federation Officers and Awards

Although the Federation of Sewage Works Associations elected new officers at their interim board meeting, these officers-elect will not take office until the regular annual board meeting on October 10th in Philadelphia. The new officers will be: President, **George S. Russell,** Consulting Eng., St. Louis; Vice-Pres., **Victor M. Ehlers,** State Sanitary Eng., Texas; Treasurer; **W. W. DeBerard,** City Eng., Chicago. The new director-at-large will be **Don Bloodgood,** Prof. of Sanitary Engineering, Purdue University.

At the annual banquet of the Federation President Francis S. Friel, Consulting Eng. of Philadelphia, made the presentation of 1947 awards as follows:

The **Harrison Prescott Eddy Award** for an outstanding contribution in research was presented jointly to Richard Pomeroy, Consulting Chemist of Pasadena, and Fred D. Bowlus, Chief Eng., Whittier, Calif., for their work on sulfide control in sewers.

The **George Bradley Gascoigne Award** for an outstanding contribution in plant operation, was presented to Leon S. Kraus, Chemist of the Greater Peoria Sanitary District, Peoria, Ill., for his paper on control of activated sludge bulking by the use of digested sludge.

The **Charles Alvin Emerson Award** for meritorious service to the Federation, was presented to Langdon Pearse for his longtime participation in Federation affairs.

The **Kenneth Allen Awards** of the Federation (not to be confused with the older Kenneth Allen Award of the N. Y. State Sewage Works Association) were presented to members of sewage works associations for meritorious service to those associations. This year there were ten recipients, of which only two were present to receive their awards: Carroll H. Coberly of the Rocky Mtn. Sect. and W. T. Knowlton of California. Other recipients cited were W. M. Cobliegh (Montana), Stuart E. Coburn (New England), H. T. Darcy (Oklahoma), W. Don-

A. J. Dotterweich
Permutit Co.
Pittsburgh, Pa.
and
Mrs. Dotterweich

Roy J. Evans
Mueller Co.
Philadelphia
and
Mrs. Evans

Mrs. "Prexy" La Due
of Akron, Ohio
and
Hubby

H. B. Shaw, Dep'ty chf.
Wash. Sub'n San. Dist.
Hyattsville, Md.
and
Mrs. Shaw

J. Clark Keith, Mgr.
Utilities Commission
Windsor, Ont.
and
Mrs. Keith

On Tour Through Glacier National Park with the W. & S. Wks. Special Party of 135 En Route East

In the two end pictures glaciers are visible in the distance. We spend a delightful night at the Prince of Wales up on Waterton Lake in Canada, and get a thrill and a pretty fair picture of the lake from a chalet balcony under full August moon. Highest point in the park shown on left—Mt. Cleveland, 10,438 ft.

aldson (N. Y.), G. R. Frith (Georgia), C. E. Keefer (Md.-Del.), Wm. Storrie (Canada) and F. W. Pinney (Dakota).

Membership Gains

Both W. H. Wisely, Exec. Sec'y of the Federation, and Harry E. Jordan, Exec. Sec'y of A.W.W.A., reported gains in total membership. The Federation has shown an increase of 631 in the past year, bringing the total to 3,998. (Since July 1 the membership has gone well over 4,000.) Member associations affiliated with the Federation now total 32. The American Water Works Association had a membership at the time of the meeting of 6,632.

Both associations picked the cities for their 1948 conventions. The A.W.W.A. will hold its 1948 meeting in Atlantic City, N. J., the week of May 3rd, and the Federation will hold its 1948 meeting in Detroit during October. In 1949 the Federation will meet in Denver if satisfactory hotel arrangements can be made, and the A.W.W.A. Board has selected Chicago for its 1949 meeting, hotel arrangements proving satisfactory.

W.S.W.M.A. Election

At the annual meeting of the Water and Sewage Works Manufacturers' Assn., held on July 23, the following member companies were elected to the Board of Governors, effective Jan. 1, 1948: Hydraulic Development Corp., Link-Belt Co., Neptune Meter Co., The Permutit Co., and Wallace and Tiernan Co., Inc. Hold-over members of the Board are: Dresser Mfg. Div., *Engr. News Record*, General Electric Co., Hersey Mfg Co., Johns-Manville, Pittsburgh-Equitable Meter Div., *Public Works Magazine*, A. P. Smith Mfg. Co., and U. S. Pipe and Fdry. Co.

Officers elected to take office on Jan. 1 are as follows:

President—Daniel J. Saunders, Vice-Pres. of Permutit Co.; Vice-Pres.—Willard F. Rockwell, Chairman of the Board of Rockwell Mfg. Co.; Treasurer—Edgar J. Buttenheim, Pres. American City Magazine Corp.; Sec'y-Mgr.—Arthur T. Clark.

Manufacturers' Assn. Brass

(President)
A. L. Paxton
Publisher, "Engr. News-Record"
New York

(President-Elect)
Dan J. Saunders
Vice-Pres.
The Permutit Co.
New York

Officers of the Divisions of AWWA

The following were elected officers of the three A.W.W.A. Divisions:

MANAGEMENT & OPERATING DIV.

Chairman—M. P. Hatcher, Director of Water, Kansas City, Mo.

Vice Chmn.—W. C. Morse, Supt. of Water, Seattle, Wash.

Sec'y—A. L. McPhail, Supt. of Water, St. Catharine's, Ont.

Directors—L. W. Grayson, Riverside, Calif.; R. M. Roper, East Orange, N. J.

FINANCE & ACCOUNTING DIV.

Chairman—L. A. Jackson, Manager Water Dept., Little Rock, Ark.

Vice-Chmn.—G. B. Schunke, Asst. Supt., Seattle, Wash.

Sec'y—J. L. Hawkins, Supt. of Water, Greenville, S. C.

Directors—J. H. Murdoch, New York; A. E. Hintz, Oshkosh, Wis.

PURIFICATION DIVISION

Chairman—C. R. Cox, State Dept. Health, Albany, N. Y.

Vice-Chmn.—I. M. Glace, Cons. Engr., Harrisburg, Pa.

Sec'y—J. E. Kerslake, Supt. Filtr., Milwaukee, Wis.

Directors—C. M. Hoskinson, Sacramento, Calif.; A. P. Black, Gainesville, Fla.

OPENING SESSION OF AWWA

The Colorado River—The Southwest's Greatest Water and Power Resource—by Samuel B. Morris, Genl. Mgr. and Chief Engr., Dept. of Water and Power, Los Angeles.

Mr. Morris reviewed the legal battles for the waters of the great Colorado River and its development to date as a water and power resource.

The Colorado, whose waters carry at times as much as 30% silt, flows through the states of Wyoming, Utah, Colorado, Nevada, Arizona, New Mexico and California and a part of Mexico. Its length is 2,400 miles and its drainage area is 242,000 sq. mi. in the U. S. and 2,000 in Mexico. The temperature of the areas drained range from 50 below

W. G. Banks, Div. Engr. Bureau of Water Newark, N. J. and Mrs. Banks

C. H. Capen, Chf. Engr. N. J. Water Comm. Wanaque, N. J. and Mrs. Capen

"Harry & Ruthie" otherwise the AWWA Jordan's of Port Washington Long Island

E. Arthur Bell Borough Engr. & Supt. Essex Fells, N. J. and Mrs. Bell

R. V. "Dick" Ford Ford Meter Box Co. Haddonfield, N. J. with Rosemary & Mrs. Ford

John L. Ford
Ford Meter Box Co.
Wabash, Ind.
and
Mrs. Ford

Karl Eden, Mgr.
Manhassett Water Co.
Manhassett, L. I.
and
Mrs. Eden

George W. Pracy, Supt., San F'rsco Wtr. Dept.; Mrs. Abel Wolman, the Professor from Baltimore, and Mrs. Pracy

Percy A. Shaw, Supt. & Engr., Water Dept.
Manchester, N. H.
and
Mrs. Shaw

Dwight B. Galt, Chm'n Wash. Sub'n Dis. Comm.
Hyattsville, Md.
and
Mrs. Galt

zero to 130 degrees in the shade. In its basin the average precipitation is only 15 in., of which the runoff reaching the river is only 10%. Its average flow in the last 20 years has been 13 million acre-feet but has in this period dropped one year to as little as 5.5 million acre-feet, with three years of less than 10 million.

The Colorado has a fall of 3,000 ft. and to date two of seven possible dams have been constructed on the river. No complete plan for the development of the Colorado has yet been produced, but it is estimated by the U. S. Bureau of Reclamation that ultimate cost of development will reach 3.5 billion dollars. At present power development is Parker Dam, 160,000 KW; Davis Dam, 225,000 KW; Hoover Dam, 1,000,000 KW, eventually to be 1,300,000 KW.

As to the allocation of water to the three states in the lower basin (Arizona, California and New Mexico) the battle goes back to 1902 when California urged a compact between these states in connection with water division through the Imperial Valley Irrigation Canal. In the Santa Fe Compact of 1922 the lower states asked for 7.5 million acre-feet but got only 1 million. In 1928 Congress authorized construction of the Hoover Dam and the All American Canal, and the Dept. of Water and Power of Los Angeles contracted to take power, bringing it in nearly 300 miles.

The fight for the use of water from the Colorado still goes on between Arizona and California. In the meantime Mexico by treaty agreement of 1945 has been allotted 1.5 million acre-feet per year. In 1931 California was allotted 1,212,000 acre-feet and in 1941 pumping was started to the Metropolitan Southern California Water Treatment and Softening Plant of 100 m.g.d., present capacity, now being enlarged to treat 200 m.g.d. The pump lift from the Colorado over the hump to Riverside is 1,640 ft. provided by specially designed single stage centrifugals. By contract California has been allotted 5,316,000 acre-feet per year from Lake Meade, which Arizona is contending to be more than California's share, while California counters that Arizona's calculations are unfair since they lay claim to exclusive use of the water of the Gila River, which otherwise would feed the Colorado. Furthermore, Arizona's proposals are not self-liquidating, says California, and the scrap continues.

The importance of the Colorado is emphasized when realizing that the water and power from this great river is ultimately to serve 10,000,000 people. The discussion disclosed predictions that within 100 years silt at the rate of 1,300,000 acre-feet deposited in Lake Meade will make Hoover Dam next to useless unless

W. J. Orchard
Gen'l Mgr.
Wallace & Tiernan
Newark, N. J.
(Entertainment)*

E. A. Sigworth
Technical Sales
"Nuchar"
New York
(Transportation)

R. C. Kennedy
Asst. Chief Engr.
East Bay Util. Dist.
Oakland, Calif.
(Local Comm.)

N. A. Eckert
Gen'l Mgr.
Water Dept.
San Francisco
(Housing)

B. I. Burnson
San. Engr.
East Bay Util. Dist.
Oakland, Calif.
(Local Comm.)

H. C. Medbery
Supt. Purif.
Water Dept.
San Francisco
(Host Comm.)

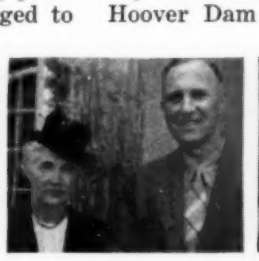
Convention Committee Chairmen and Hosts

*(*Also General Chairman of Convention Management)*

Arthur L. Shaw
Metcalf & Eddy, Engrs.
Boston
and
Mrs. Shaw

Egmont Smith
Neptune Meters
Dallas, Tex.
and
Mrs. Smith

Rosemary Ford
Mary Wood
Walter Shea
State Sanitary Engr.
Providence, R. I.



L. D. Matter, Dist. Engr.
Pa. State Dept. Hlth.
Harrisburg, Pa.
and
Mrs. Matter

E. Sherman Chase
Metcalf & Eddy, Engrs.
Boston
and
Mrs. Chase

Harvey P. Jones
Jones & Henry, Engrs.
Toledo, Ohio
and
Mrs. Jones

Chas. P. Abraham
Supt. of Water
Lancaster, Pa.
and
Mrs. Abraham

Francis S. Friel
Cons. Engr.
(President F.S.W.A.)
and
Mrs. Friel

Lloyd Nelson
U. S. Pipe & Fdy. Co.
Philadelphia
and
Mrs. Nelson

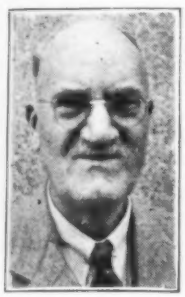
Wm. F. End, V.-P.
Ross Valve Co.
Troy, N. Y.
and
Mrs. End

other dams planned to help this situation are constructed.

The Problems of Water Development of Pacific Islands—by Frederick Ohrt, Manager, Bd. of Water Supply, Honolulu, T. H.

Mr. Ohrt's paper dealt primarily with the question of salt intrusion, and how this problem is dealt with in ground water development on the Hawaiian Islands.

Mr. Ohrt said that the islands were formed by successive layers of lava which have been deeply eroded. On the interior of the islands precipitation mounts as high as 400 in. per year while 20 in. is normal along the coast. Because of the long dry season and high evaporation rate the islands must depend upon ground water almost exclusively. The "lens" of fresh water is similar to that of Holland and is found very deep down because of the higher gravity of the salt water layer which comes in from the ocean and extends at the coast line to a 300 ft. depth. The problem is to lift the fresh water without forming a cave which will permit the salt water above to penetrate the fresh water lens. To preclude the latter the use of so-called "skimming tunnels" has been resorted to as the safest method of withdrawing fresh water. Only recently have "recharging tunnels" been introduced as a means of maintaining the fresh water level.



Federation Award Winners

Langdon Pearse
Chief San. Engr.
Chicago San. Distr.
Chicago
(Emerson Award)

L. S. Kraus
Supt. Treatment
Peoria San. Distr.
Peoria, Ill.
(Gascoigne Award)

Mr. Ohrt pointed out that the average safe yield of ground water on the Hawaiian's can only be taken as 25% of the annual precipitation, but there is approximately a 40 ft. depth of fresh water for each foot of elevation above sea level and many wells yielded fresh water at a depth 42 ft. above sea level originally and this elevation of the fresh water lens fluctuates with cycles of dry and wet years.

Hydro-Pneumatic Pumping Stations—by O. G. Goldman, Asst. Supt., Water Dept., San Francisco.

Mr. Goldman described the use of hydro-pneumatic pressure booster stations to serve small areas as a substitute for elevated storage. If the maximum hourly water demand for the area to be served is known the size of tank required can be calculated. The pump capacity must be equal to this maximum hour demand or a little greater. The volume of air maintained in the tank by automatically operating compressor must be in ratio of 10 parts air to 1 water. However, the compressor, of 1½ to 3 cu. ft. min. capacity, operates only infrequently to maintain this ratio of air. To provide fire flows into the area served the pneumatic tank is bypassed and the booster pumps deliver directly into the mains through otherwise closed check valves. Mr. Goldman described one installation serving 6 city blocks requiring twin 8x25 ft. tanks and pointed out that with these pneumatic tank booster stations they had not had to limit lawn sprinkling in the areas served. A variation of only 10 lbs. pressure is automatically maintained at all times by these stations.

FIRST JOINT SESSION A.W.W.A. AND F.S.W.A.

Ground Water Pollution Problems

Under the presiding gavel of Wendell R. LaDue, Pres. of the A.W.W.A.,

Federation Award Winners

Richard Pomeroy
Consul. Chemist
Pasadena, Calif.
(Eddy Award)

Fred D. Bowlus
C'f Engr., Sewer Dist.
Whittier, Calif.
(Eddy Award)

the first joint session of the Amer. Water Works Assoc. and the Fed. of Sewage Works Assoc.'s heard papers on "Ground Water Pollution Problems."

"Basic Concepts in Ground Water Law"—by A. P. Black, Prof. of Chemistry, Univ. of Florida, Gainesville, Fla.

Prof. Black introduced the topic with the comment that ground water use was on the increase because of its uniformity of temperature, com-

R. M. Roper, Gen. Mgr.
Board of Water Comm.
East Orange, N. J.
and
Mrs. Roper

T. C. Schaetzle, Supt.
Sewage Treat. Wks.
Akron, Ohio
and
Mrs. Schaetzle

Robt. G. Kincaid
Burns & McDonnell
Engrs., Kan. City, Mo.
and
Mrs. Kincaid

W. G. Kirchoffer
Cons. Engr.
Madison, Wis.
and
Mrs. Kirchoffer

W. E. Collings, Supt.
Water & Sewage Wks.
Collingswood, N. J.
and
Mrs. Collings

position, purity and other advantageous characteristics. Laws for the control of ground water vary from state to state.

Programmers

A. Wolman, D.Sc.
Prof. San. Eng.
Johns Hopkins U.
Baltimore, Md.

Sheppard T. Powell
Consulting
Chemical Engr.
Baltimore, Md.

There are five basic principles or concepts which a ground water control law should consider. These are (1) that all ground waters are public; (2) beneficial use shall be the basis of control; (3) it shall be administered by a state authority; (4) the law shall be subject to review and shall provide for the rights of users and non-users; (5) they shall exempt the water for domestic use. If all five of these points or phases are given consideration in the development of a ground water law, such a law would be reasonable in its control.

Prof. Black mentioned three basic foundations in considering the laws controlling ground water. The first of these is common law, which grants absolute ownership of ground water to the property owner. This is opposed to the riparian rights law of surface waters and the basic ideas of the two should never be confused. The second foundation or law is the rule of reasonable use or the doctrine of correlated rights, whereby the waters are apportioned on the basis of that available. This rule has several serious limitations, one of the greatest of which is the difficulty in determining what is reasonable use. The third basic foundation is the doctrine of prior appropriation, which simply states that the man who gets the water first can have it. Such a doctrine raises the question as to whether or not it violates the fourteenth amendment. The development of a good law for the control of ground water must consider all three of these possible foundations.

Although some persons consider ground waters as being only those which percolate, others consider ground water as a water moving in an indefinite underground stream. Prof. Black believes it should simply be called ground water and that no limitations should be placed on its boundaries. In the administration of laws covering ground waters, the Professor believes that there is need for good state engineers and for the collection of field data. Prof. Black cited several examples of laws in different states and commented that, whereas the right of eminent domain should be reserved to cities, prior users should be reimbursed if the city takes this water.

In the discussion which followed Prof. Black's paper, S. B. Morris, Gen. Mgr. of the Dept. of Water and Power in Los Angeles, said that many cities were faced with diminishing ground water supplies but wanted to continue over-development because they needed the water to bring in the industry which would eventually make it possible for the municipality to afford to develop other water supplies. Mr. LaDue

Programmers

Samuel B. Morris
Chf. Engr. & Gen. Mgr., Dept. Water & Power
Los Angeles

Frederick Ohrt
Mgr., Board of Water Supply
Honolulu

raised the question as to use of wells for waste disposal and Prof. Black replied that many ground water sources had been spoiled by wastes discharged into such wells. Mr. LaDue then asked about spent air conditioning water being returned to the ground and Prof. Black replied that the trend is to conserve ground water by limiting its use for air conditioning.

"Ground Water—A Neglected National Resource"—by Malcolm Pirnie and R. W. Sawyer of Malcolm Pirnie, Engineers, New York.

Mr. Pirnie, who presented this paper, used slides to illustrate the ground water supplies discussed and he emphasized the need of laws to control the development of ground water supply.

In the first place a sound conception as to the source of water is needed. Many persons believe that ground water is an inexhaustible spring or that it is a flowing underground river, and too few persons realize that the real source of ground water supply is the rainfall on the land above. The need for ground water studies was emphasized by Mr. Pirnie, who expressed the opinion that the cut in Federal funds for ground water studies was a mistake. Mr. Pirnie then proceeded to cite several instances in which ground water was the only source of water available and adequate data from prior studies of these sources would have made possible the rapid development of the supply. These supplies in particular were needed on short notice during the war and it was lack of prior studies to determine local ground water conditions that delayed war production in many instances.

On the basis of the experiences developed in these four instances, including Schenectady, N. Y., Fort Dix, N. J., and two army camps on the west coast, Mr. Pirnie concluded that our huge reservoir of ground water constituted a national resource both in time of peace and in time of war and that studies to adequately determine the extent of this national resource could be adequately justified. He further emphasized that these studies should be carried on by the U. S. Geological Survey.

"Formulating Legislation to Protect Ground Water from Pollution"—by B. E. Doll, Deputy City Eng., Huntington Park, Calif.

Mr. Doll pointed out that there are three concepts which must be considered in formulating legislation to protect ground water against pollution. These are that ground water is used for three different purposes—domestic, agricultural and industrial, and each of these uses may tolerate different concentrations of impurities.

When one is asked why legislation is necessary or what could possibly pollute ground water, the answer is readily available from experiences in Los Angeles, Montebello, Phoenix and elsewhere. Mr. Doll

Programmers

R. F. Goudey
Chf. San. Engr. Dept. Wtr. & Pw'r
Los Angeles

A. P. Black
Prof. of Chemistry
Univ. of Fla.
Gainesville, Fla.

cited a Los Angeles well that was ruined by sulphuric acid waste, the famous Montebello incident where 2-4-D waste ruined the water supply, and in Phoenix where a sewage well discharged into the center of a group of water wells.

Thus with the knowledge that ground water can be and often is polluted, legislation is warranted to protect ground water from pollution. In preparing such legislation the three different uses of water should be considered, for not all wastes present problems in public health but may affect potability, esthetic qualities, or use of water for either agriculture or industry. Furthermore, it must be remembered that wastes discharged into surface streams do not behave like wastes discharged into ground water. In surface streams there are mixing, turnover, wind and wave action, dilution, etc. In ground water the waste may be introduced into the aquifer and be diluted to but a very slight extent because of the lack of movement of the water.

In considering legislation for protection of ground waters, the present day standards of water supply must be maintained for ground waters as well as for surface waters. California has made studies in an attempt to develop laws to prevent pollution of underground water flows.

Mr. Doll suggested that a state water authority board should be formed and that this board should consist of representatives of all interested parties. Enforcement of the law should be by local sub-divisions or by the authority. Permits should be granted by the local body, but state planning and standards are absolutely essential. Mr. Doll concluded with the thought that our "water supplies must be protected or our wastes will destroy us."

"Developing Standards for Protection of Ground Water"—by R. F. Goudey, Principal San. Eng., Dept of Water and Power, Los Angeles.

Mr. Goudey also pointed to the fact that there are a number of uses of water, some of which are incompatible with others. These uses include human consumption, irrigation, industrial supply, transportation, recreation, and a means of sewage disposal. Ground waters are not used for all of these purposes, their use being restricted more to human consumption, agriculture, and industry. It may also at times be used as a means of waste disposal and here the cleavage between the two uses is sharper than in the case of surface supply. Therefore, the development of standards for protection of ground water pollution involves more than just the state health department. There are the problems of multiple use to be considered. Several states now have advisory boards on stream pollution control and the trend is in the direction of getting industry, health authorities, and citizens at large on the legal control board.

At the present time there are several states which have stream control boards, including Pennsylvania, Connecticut, Louisiana, Virginia, West Virginia, and Michigan. In addition there are other pollution control boards such as the Interstate Sanitation Commission of New York, New Jersey, and Connecticut; the Potomac River Basin Commission; Incodel, the Interstate Commission on the Delaware River, and the Ohio River Compact which has not yet gone into effect. All of these are concerned with surface water pollution. There are no commissions dealing with ground water protection.

In the matter of developing standards for the protection of ground water pollution, Mr. Goudey points out that such standards must consider natural changes in ground waters, the discharge of wastes, the fact that irrigation waters pick up calcium, magnesium, sodium, potassium, and nitrogen from fertilizer. Also, overdrawing must be considered, as must the effects of oil well brines and other industrial wastes.

Industry has a number of legal rights to water supply, but Mr. Goudey states that where ground water is overdrawn, industrial wastes should certainly not be added to the ground. Ground water should be classified as to suitability for specific uses. Such classification is essential to the development of standards for the protection of ground waters. Mr. Goudey concluded with the presentation of standards for four types of water used for irrigation.

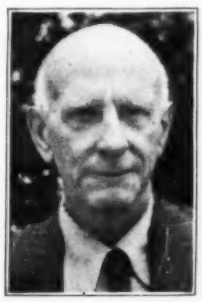
Discussion of papers by Messrs. Doll and Goudey was led by **Frank M. Stead,** Acting Chief, Bureau of San. Engineering, Calif. Dept. of Public Health, Berkeley, Calif. Mr. Stead re-emphasized the conflicting uses of water and stated that the standards of water for the highest use of that water should control the impact of pollution on the ground waters. One solution proposed to the problem is to classify areas and set up standards, but small areas cannot be zoned.

Mr. Stead presented two examples of how ground water pollution problems were solved by a cooperative approach to the problem with the industry. One was the case of oil wastes, where not only oil but chemicals and phenols were signficant. The approach was to whittle down the various wastes to the absolutely irreducible minimum waste discharge. This discharge, it was found, could be safely absorbed into the water aquifer. The second example was that of a paper mill waste in which case again all factors were considered and a reasonable solution arrived at to the benefit of all concerned.

John G. Copley
Supt.
Water Dept.
Elmira, N. Y.

Clifford H. Fore
Supt.
Water & Sewage
Carbondale, Ill.

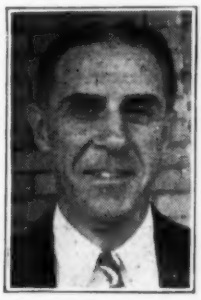
L. J. Hoffman
Office Mgr.
Water Dept.
Akron, Ohio



H. N. Lendall
Prof. San. Eng.
Rutgers Univ.
NewBrunswick,N.J.

Geo. W. Fuller Award Recipients

G. B. Schunke
Asst. Supt.
Water Dept.
Seattle, Wash.



C. F. Wertz
Resident Engr.
Water & Sewage
Miami, Fla.

At the Sewage Works Federation's Dinner

The Los Angeles Sewer Maint. Div.'s table

Pres. Friel hands W. T. Knowlton Kenneth Allen Award Certificate

Geo. A. Parkes Pres. California Assn. at the Mike

President Friel making the Eddy Award to Pomeroy and Bowlus

Diners listening to John Gill's protege's songs

SECOND JOINT SESSION A.W.W.A. AND F.S.W.A.

The Reclamation of Sewage Waters

Under the presiding gavel of Francis S. Friel, President of the Sewage Works Federation the second joint session of the Water and Sewage Works Associations heard papers dealing with "The Reclamation and Re-use of Sewage Waters."

How extensive is the use of reclaimed sewage effluents, what factors affect this use, and what is the potential future development of this practice? These questions provided the subject of one joint session of the F.S.W.A. and A.W.W.A. Presiding chairman of this symposium was Francis S. Friel, President, F.S.W.A. Four technical papers were presented.

"Industrial Uses for Reclaimed Sewage Effluents" — by N. T. Veatch, Vice-President, A.W.W.A., Black and Veatch, Engineers, Kansas City, Mo.

Mr. Veatch emphasized that the desire to recover something of value from sewage is not new: the broad irrigation of land is an old practice but is still in use. The use of sewage sludge in many locations accomplishes a reduction in the cost of disposal but is not a profitable enterprise. Only when the water is recovered, rather than the solids portion, can profits be realized.

The use of the water portion (sewage effluents) is rather widely practiced and may represent real economic possibilities, but certain topographic limitations must be recognized. Established uses are restricted to instances where water supplies are inadequate or are non-existent, and where the treatment required is neither difficult nor expensive. Future applications are likely to be made where the same conditions apply.

Salvage of sewage effluents for industrial purposes is quite limited. In reply to a questionnaire sent to State Health Departments, and based on subsequent correspondence with cities involved, it appears that only nine cities use or contemplate this use of sewage effluents, and that only four cities actually obtain revenue from the sale of effluent. The revenue-receiving cities listed by Mr. Veatch are: Harrison, Kansas; Grand Canyon, Arizona; Corpus Christi, Texas, and Baltimore, Md.

At Harrison, a net yearly revenue of $1,600 is received from the sale of activated sludge plant effluent to a railroad softening plant. The sale of water from the Grand Canyon plant (activated sludge followed by conventional methods of water purification) at $2.00 per thousand gallons, compares with a cost of $3.00 per thousand gallons for water hauled by railroad to this location. Approximately 150,000 gal. per day of reclaimed sewage effluent is sold at this location for non-potable uses (despite its excellent bacterial quality—less than 1.0 per cent of 10 cc. portions examined show positive presumptive tests—all pipes in the distribution system are painted a bright red for identification). At Corpus Christi, effluent from trickling filters was used during two years of the war for cooling water, chlorination for slime control being the only additional treatment provided. The use at Baltimore, described in detail in a following paper, is the highest quantity use of all.

Other municipalities which make use of sewage effluents or are contemplating such use are: Big Spring, Tex.; Enid and Duncan, Okla.; Providence, R. I.; Cheyenne, Wyo.; Grand Island, Nebr. Mr. Veatch said that there are 135 instances, in 18 states, where sewage effluents are used for irrigation. Sewage effluents should be considered a natural resource—they are frequently of better quality than the raw waters available for industrial uses—and it is probable that much more use will be made of them in the future.

In a prepared discussion by Earnest Boyce, Professor of Municipal and Sanitary Engineering, University of Michigan, it was pointed out that, unfortunately, not all wastes are susceptible to biological treatment. For example, oil field brine wastes cannot be so treated—but they might be kept separate and be re-used. Mr. Boyce was unable to attend and his paper was read by Mr. F. W. Gilcreas (Division of Laboratories and Research, Albany, N. Y.).

Mr. R. F. Goudey, Department of Water and Power, Los Angeles, called attention to the lack of a fair and business-like basis for evaluating the value of reclaimed sewage effluents, and recommended a study of the true economics of this application.

E. A. Schmitt, Chief Div. of Water Supply Distr. of Columbia and Mrs. Schmitt

J. A. de Camp Pres. Nat'l Water Main Cleaning Co. New York and Mrs. de Camp

B. H. Swab Jones & Henry, Engrs. Toledo, Ohio

Mother Swab and sister Blanche

A. L. Lash President Geo. A. Caldwell Co. Boston and Mrs. Lash

J. Arthur Carr Supt. of Water Ridgewood, N. J. and Mrs. Carr

Some Scenery and Atmosphere Up in Glacier Park

(All but the center picture of some of the boys glimpsing famed Multnomah Falls on the Columbia River Highway.)

"Use of Reclaimed Sewage Effluents in Baltimore"—by Abel Wolman, Professor of Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

Dr. Wolman did not read his paper, but summarized its context and stressed the implications of this application. Three important items must be considered: First, resistance on the part of the public; second, the equally difficult problem of meeting official laws and regulations; third, residual technological problems.

Since 1941, the use of sewage effluent has been a successful practice, and now the capacity of the undertaking is being doubled. The original installation at Baltimore was designed for a maximum capacity of 15 mgd., additional capacity is to be in service at the end of this year, and it is expected that capacity will be as much as 100 mgd. within three years.

The Bethlehem Steel Co. plant at Sparrows Point, Maryland, now requires 185 mil. gal. of water daily in its manufacturing processes. This volume is almost equivalent to the entire consumption of the city of Baltimore, and about 150 mgd. must be fresh water. Since the original source (ground water) has become depleted, an economical alternate source was essential. Requirements were based on producing a process water having a temperature below 75° F., chlorides below 175 ppm., suspended solids below 25 ppm., and with an organic and corrosion potential as low as possible. All water sources were abandoned in favor of sewage plant effluent.

Baltimore first offered to give the sewage effluent to the steel company, but the company preferred to pay in order to exercise some control. The original agreement was for up to 50 mgd. at $500 per month. The agreement has now been extended on a sliding scale increasing payment to take up to 100 mgd. The steel company has spent some two million dollars for its treatment plant, pipe, impounding reservoir, and distribution system; it controls all treatment of the effluent.

The city of Baltimore has scrutinized effluent quality and has found amazing and disconcerting discrepancies in daily, weekly, and seasonal variations. Dr. Wolman noted that reclamation of effluents will proceed more rapidly if competent exploration is made of the psychological, technical, and official factors which affect this practice.

"Agricultural Uses of Reclaimed Sewage Effluents"—by L. V. Wilcox, U. S. Rubidoux Laboratory, Riverside, Calif.

While the author believes the conservation and use of sewage effluents should be encouraged, he indicated that nearly all such projects have been unprofitable, or inadequate, or produce effluent of unsatisfactory quality for irrigation. He attempted to define properties which make effluents satisfactory for use in irrigation.

All natural waters must have low concentrations of constituents such as boron, silicon, etc., to be suitable for watering crops. Boron is particularly significant, less than 0.5 ppm. is safe for any crops, but even 1.0 ppm. may injure sensitive crops. Soft water makes "hard land" and the reverse is true of hard water.

By means of slides, the author showed the relative tolerance of crop plants to boron. He illustrated chemical analyses of important streams now used to divert water for irrigation. He compared these analyses with those of effluents from sewage disposal plants of Southern California.

Sewage effluents exhibit a higher electrical conductance than natural water supplies and, generally, a higher concentration of boron. Since solutions of boron are commonly employed for washing fruits in processing factories, this objectionable constituent is a commonly found contaminant in effluents.

In discussing this paper, Dario Travaini, Supt., Disposal Plant, Engineering Dept., Phoenix, Ariz., described the great value of all water in the arid Southwest States. The effluent from the Phoenix activated sludge plant, after chlorination, passes U. S. P. H. S. standards for drinking water. More heavily contaminated raw water is frequently used for irrigating crops—yet State Health Departments usually frown on the use of sewage effluents on crops or vegetables not cooked before use. There is a lack of suitable standards affecting the use of effluents.

"Limits of Pollution of Water for Industrial Use"—by S. T. Powell, Consulting Chemical Engineer, Baltimore, Md.

Mr. Powell pointed out that no specific standards are possible, since water must be processed to meet the needs of each particular industrial process. Hence, he preferred as the title for his paper, "The Effect of Stream Pollution on the Quality of Water Supplies."

The largest single use of industrial waters is for cooling purposes, and water quality is important even in this application. Temperature must not be too high, slime-forming bacterial growths must be controlled, and water should be free from pyro-

John J. Horgan
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and
Mrs. Horgan

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Jack Faulks
Neptune Meters
Maplewood, N. J.
and
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Alan A. Wood
Luther & Wood
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Gen. Mgr., Water Wks.
Des Moines, Ia.
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gens (bacteria which can tolerate high temperatures). Sewage has the effect of increasing organic contaminants, and may introduce a difficult problem in water softening.

Organic and inorganic acids or compounds may react on pumps and other equipment. The attack of ammoniacal substances on copper and copper alloys must be considered. Altogether, industrial management has not fully recognized the losses which may be attributed to sewage pollution of water supplies.

Dr. A. M. Buswell, Chief, State Water Survey, and Research Professor of Chemistry, University of Illinois, Urbana, Ill., discussed Mr. Powell's paper. He commented on the nitrogen content of sewage effluents as a stimulant for water plants; nitrification must be complete for this action—it will not be brought about by ammonia nitrogen. Ammonia may be the source of energy for bacterial growth where sunlight is not involved. Dr. Buswell repeated the warning, stressed by preceding speakers, that better control of plant operation will frequently be required if sewage effluents are to be safely used—because there is a general lack of knowledge concerning the quality and variation of what is discharged.

Joint Session Management and Finance Divisions

In the absence of S. S. Anthony and C. H. Lamb, respectively chairmen of the Plant Management Division and the Finance and Accounting Division, the first joint session of these two divisions was presided over by Melvin P. Hatcher, Director of Water, Kansas City, representing the Plant Management Division, and J. L. Hawkins, Sup't. of Water, Greenville, S. C., representing the Finance and Accounting Division.

Revenue Bond Legislation

"Recent Revenue Bond Legislation" was the title of a paper presented by **L. N. Thompson,** Gen. Mgr., Water Dept., St. Paul, Minn. Mr. Thompson called attention to the fact that there is a wide variety of legislation on the books throughout the country at the present time. There is no standard code in this matter. Financing of water works utilities was originally done by taxation on property and general obligation bonds. This system is gradually giving way to the use of revenue bonds because revenue bonds do not constitute a debt on the city, and thus general obligation bonds need not be curtailed.

Another advantage of the revenue bonds is that they side-step the difficulties and problems involved in general obligation bond financing where there are decreasing assessment values because of the decline in property values and a growth of the suburbs at the expense of the city, all factors which tend to make general obligation bond financing more difficult.

With 155,000 units of local government, Mr. Thompson pointed out that there is obviously uneven distribution and overlapping of such units. He suggested, therefore, that utilities should try operations under authorities as a means of solving both their financial and operating problems. Municipal officials are generally not well informed on the use and operation under such authorities. For one thing the legality of authorities of this type is not entirely clear as the practice varies in several states. For example, in one state it is required that 90 per cent of the landlords must vote for the establishment of an authority, and in New York State there must be specific legislative acts for the establishment of an authority for each city. An authority is, of course, a corporation which does not have to have the vote of the people in order to issue its bonds or spend its money. Debt of the authority is not limited by the state limitation on municipal bond issues. Such corporations have been growing in popularity but are not too generally established yet because of the lack of information and legislation. Such authorities always operate on self-liquidating revenue bonds.

Art Clark's Water Well

At which many met in the exhibit hall, recalling the slogan "Meet me at the Well."

Mr. Thompson said that self-liquidation is fine but it must be sound. It can be bad, and if so will bring into dispute all revenue bond legislation. Revenues should be at least 12 per cent of the original debt, rates should meet all operating expenses, etc., and still allow 10 per cent for debt retirement.

Revenue Bond Financing Experiences

Experiences in revenue bond financing with particular reference to Los Angeles were discussed by **S. B. Robinson,** Attorney of Los Angeles, Calif. Mr. Robinson for many years was associated with the Los Angeles Water & Power Dept. A charter amendment in Los Angeles made possible revenue bond financing which had been made use of both for the water system and the power system of the Los Angeles Water and Power Dept.

In considering the adoption of revenue bond financing, the first concern is the need for adequate legislation by charter or by state act. The charter of Los Angeles, or any other individual city, probably will not fit general cases as such charter changes must be made to fit local conditions. One of the questions to be answered is "Where should the power to authorize bonds rest?" It may rest with a special board, a general legislative authority, or with the voters.

Mr. Robinson agreed with Mr. Thompson that it may be desirable to organize an authority, but he also believes that it is possible in a department, board or commission to function in a similar manner. In any event the voters should get a chance to say where the power for issuing bonds should rest, but that the board or authority should have the power to issue bonds as needed.

Mr. Robinson explained provisions of the Los Angeles charter, its limitations, and pointed out that these limitations consisted of constitutional limits, limits by general laws, limits by new legislation, and limits by authorization of covenants. Mr. Robinson also commented on the board special fund theory and why it is not sound, as opposed to a general law with limitations to prevent overloading of the authority.

L. E. Langdon
and
Harry Schlenz
Pacific Flush Tank Co.
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C. A. Erdahl, Util. Com.
Wm. A. Kungik
Engr. & Supt. of Water
L. W. Craig, Fin. Com.
Tacoma, Wash.

R. E. McDonnell
and
R. G. Kincaid
Burns & McDonnell
Kansas City

Virginians*
W. B. Harman
Asst. Gen. Mgr. Newport News Water Comm.
Chas. E. Moore, Mgr., Roanoke Water Works
X. D. Murden, Supt. Portsmouth Wtr. Dept.

E. A. Schmitt, Chief Engr., Div. Water Sup. U. S. Engrs. Office Washington, D. C.
W. G. Kirchoffer
Consulting Engr.
Madison, Wis.

*(*Harman is immediate Past Chairman; Murden is Chairman, and Moore is Director from the Virginia Section.)*

Terms of bonds should not be longer than the life of the project which they pay off, generally 40 years for public works. There should be a provision for redemption, since it frequently becomes desirable to redeem bonds.

Competitive bids for bonds versus negotiated sales were also discussed. In some cases private sale may be better than the competitive bid.

It is of interest to note that in the marketing of water and power bonds, water works revenue bonds are more easily sold than power revenue bonds, probably because this type of financing is older in the water works industry than in the power industry. In the case of power, before such bonds can be sold an engineer's report on the power department must be given. This is not true of water works bonds. In turn, sewer revenue bonds require even more detailed investigation by engineers than do power revenue bonds.

Mr. Robinson is convinced that revenue bonds are good for a utility as they put the utility on its mettle to produce and operate as an economically sound enterprise.

Rates Vs. Rising Costs

Under the title **"How Shall Rate Structures Be Adjusted to Meet Rising Cost Levels?", Louis R. Howson,** Consulting Engineer, Chicago, raised and answered three questions. These questions were (1) Do water works need increased revenue? (2) If an increase is required, how much? and (3) How should the rate structure be adjusted to yield the increased revenue required?

The necessity for increased revenues in water utility may well be indicated by a comparison of the quantities of water used with the amounts of coal, steel, wheat, cement used annually, and a comparison of the cost per ton of these respective commodities.

Visitors from Afar

H. F. Zaghloul
Egyptian Ministry of Hlth.
Cairo

E. L. Bartz
Board of Water Supply
Honolulu

Whereas approximately 1800 million tons of water are used each year compared to some 800 million tons of coal, and perhaps 200 million tons of steel, the cost of water is but 4 cents per ton compared to $3.18 per ton for coal, and approximately $60 per ton for steel.

In addition to being a commodity, water is also a transportation service. Compared to railroad transportation, which costs more than 0.9 of a cent per ton mile, water as a transportation service brings but 0.3 of a cent per ton mile.

Consider with these observations, the fact that the cost of living has increased above pre-war level by 55 per cent, wholesale prices have increased by 60 per cent, and railroad freight rates have increased approximately 18 per cent, while water generally has shown no price rise above pre-war cost.

Mr. Howson's data showed that the per cent of revenue used for operating cost dropped from 50 plus to 49 in the first year of the war; it has risen steadily since, and in 1946 it required more than 54 per cent of the revenue to satisfy operating cost. In the 20 year period from 1925 to '45 the ratio of operating expenses to revenue increased 6 points. In the single year from 1945 to 1946 this ratio increased 3 points or half as much as in the previous 20 years. Thus it is observed that net revenue is being drastically reduced at a time when there is simultaneously a sharp increase in the cost of items for which it has normally been expended, according to Mr. Howson. These facts point to the apparent need for increased revenue required by water works.

From a tabulation of gross revenue per consumer for an average of 100 water works in 1945 and the

J. R. Wolfs, Oper. Engr.
Southerly Treat. Wks.
Cleveland, Ohio
and
Chas. G. Bourgin
Supt. of Water
Montclair, N. J.

W. F. McMurry
Supt. of Water
Tulsa, Okla.
and
Albert R. Davis
Supt. of Water
Austin, Tex.

Four Aces—
all Shaws
Percy, from Manchester, N. H.; Arthur, from Boston; Harry, from Hyattsville, Md., and Leland, also of Wash. Suburban San. District.

Jim Kennon
Managing Engr.
Bureau of Water
Pittsburgh, Pa.
and
Ross Scott, Engr.
Dresser Industries
New York

F. B. McDowell
Asst. Mgr. & Engr.
Dept. Wtr. & Pub. Wks.
Charleston, S. C.
and
H. R. Walrath
General Electric Co.
Schenectady, N. Y.

operating expenses before depreciation, Mr. Howson showed that the net income before depreciation was $14.65 per consumer. National pattern wage increases of recent years with the consequent increase in fuel, maintenance, and material costs have or will increase the operating cost per consumer above prewar costs by about $4.70, thereby reducing the net income from $14.65 to $9.95 per consumer. In the past, water works normally have spent about $7.35 per consumer for new construction, leaving $7.30 for fixed charges, returns, etc. Mr. Howson states that "on the assumption at least that this latter amount will be required for those items in the future, the amounts available for new construction out of the $9.95 will be reduced to but $2.65 per consumer. This $2.65 however will not purchase as much construction as pre-war." If construction and other costs are to be maintained at prewar rates, then the water rates must be increased approximately 30 per cent if water works are to progress in the future as in the past, according to Mr. Howson.

Mr. Howson went on to present the rise in construction cost index to show that pre-World War II construction prices will never return, although there may be some recession from present levels as black markets in both labor and materials are dissipated by abundant supply. It appears that any expansion program for the next decade should be based on construction costs ranging from 60 to 75 per cent above those prevailing in 1939. Obviously then with the high cost of construction and the absolute need for continued progress in the expansion and improvement in water supply facilities, and the decreased returns of net income, there must be an increase in water rates.

As to where the increased revenues will come from, Mr. Howson presented a general pattern with no specific details. The extent of the increase required will vary between wide limits depending on a number of factors, including how much deferred maintenance has accumulated, whether the individual water works property has adequate facility, the adequacy of past revenue, the labor situation, rate of growth, expansion of facilities, etc.

Mr. Howson points out that now is the time to increase the rates and that such increases should be made sufficiently large, when the public psychology is favorable, rather than making repeated adjustments upward in the rate schedule. One method is to set the rate schedule at higher than the revenues needed and then allow a discount until such time as the monies are required. Where the present rate schedule is unsatisfactory, it may be desirable to develop an entirely new schedule of rates. Such a schedule must anticipate operating and maintenance expenses including depreciation, fixed charges, and the average requirements for plant expansion. Such rates must also consider the distribution of consumers and a classification according to their uses. Mr. Howson presented a graph showing classifications by percentage and the quantities of water generally used by those classifications. From this graph and a consideration of the rate structure it is possible to set up a proper rate system. Mr. Howson illustrated his structure by an example showing how to develop the proper rates for both the residential user and the large volume user. At least two water utilities have already raised their rates, one by a straight 50 per cent increase and another by a complete rearrangement of the various steps.

Mr. Howson summarized his paper with the conclusions that most water works should increase revenues within the near future and that the general average increase will be approximately 30 per cent. Where present rate schedules are satisfactory and equitable the simplest change is through application of a uniform percentage, but in other cases a complete rearrangement of existing schedules may be required as there can be no 100 per cent equitable rate schedules; each must be necessarily tempered with some expediency. (Mr. Howson's paper is printed in full elsewhere in this issue.)

Water Main Extension Policy

Under the panel leadership of **W. Victor Weir**, Pres., St. Louis County Water Co., the "Elements of Water Main Extension Rule Policy" were set forth and discussed. Mr. Weir presented the basic considerations after which each member of the panel discussed some of the details from various points of view.

The panel statement pointed out that equitable extension rules covering financing and installation of water mains to supply new customers should cover the various phases of extension policy in nondiscriminatory fashion.

Extension rules should not favor new customers to the extent that main extensions will increase the cost of water to old customers. New customers should, however, be enabled to receive water at the lowest reasonable cost. Generally, revenue from new customers should exceed the cost of supplying water including carrying charges on plant, property, and mains.

It is believed that one basic rule to apply to all new customers is fairest, although distinct classes of new customers may require special rules. In the case of private utilities, approval of the rules must be obtained from regulatory commissions. The rules should be comprehensive.

The utility should determine the size of pipe to be used and estimate the cost of the installation and refund any overpayment if the actual cost is lower.

According to the panel statement the new customer or real estate developer shall pay in advance, for the cost of extension, but the utility must make known the basis on which it will make its investment in the new main, such as allowance for number of feet of pipe or refunds for additional consumers.

As to refunds, these should never exceed the original cost of the extension and refunds should not be made after a stated period, nor should interest be paid on unrefunded balances.

The title to the extension should remain with the utility regardless of consumers' advances or unrefunded contributions, and the utility must have full control over the main after construction with the right to make additional extensions beyond or laterally as it desires.

The panel statement concluded with emphasis that no private mains should be allowed, that changing conditions call for periodic review of the rules, and that a standard contract form should be developed for each utility.

After Mr. Weir's presentation of the above statement, the members of the panel presented discussions mirroring their individual points of view. Those who spoke on the subject included **E. F. Dandridge**, Chief Clerk, Bur. of Water Works and Supply, Los Angeles; **John Murdoch**, Attorney, Amer. Water Works and Elect. Co.; **M. P. Hatcher**, Dir. of Water, Kansas City, Mo., and **L. S. Finch**, Ch. Engr., Indianapolis Water Co., Indianapolis, Ind.

(This report will be continued in our October number.)

SHOULD PUBLIC WATER SUPPLIES BE USED FOR MASS MEDICATION?*

By ABEL WOLMAN, Sc.D.
Prof. of Sanitary Engineering
JOHNS HOPKINS UNIVERSITY
BALTIMORE, MD.

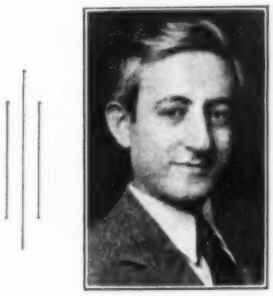
THE application of chemicals to water for the purpose of clarification and the removal of organisms is one of the oldest of the arts of water treatment. Centuries have passed since people first learned by empirical observation that it was possible to improve the quality of water by the addition of various chemicals. Much of this practice was initiated long before the modern principles of chemical reaction were understood.

Conscious consideration of the possible effects on the human organism of the addition of chemicals to water is relatively recent, arising only during the last 60 years. Even today our understanding of some of these effects is still hazy.

Water supply practitioners have, however, a perfectly reasonable basis for the use of the chemicals normally listed in our texts as devoid of deleterious effect. Even where this direct evidence is limited, the positive known advantages to the populations of the world resulting from chemical processing of water outstrip by far the hypothetical and undemonstrated possibilities of objectionable results.

This is not to say that some individuals in 1947 here and abroad still do not view with caution the suggestion that waters be coagulated with alum, disinfected with chlorine or treated with copper. For example, in Great Britain recently, D. G. Davies[1] made the following comment: "Until we know more about the effect of aluminum on health, water engineers should be very chary about its use." Further in his paper, he goes on to point out the "need for care in utilizing any chemicals whose action on the human frame was unknown." In a discussion of this paper, Dr. Greenshields makes a rather severe criticism of the use of alum without some limitation on effluent concentration. He suggests, however, that pure water does not occur naturally and is not even wholesome, "because of its anisotonicity with living cells. To meet the physiological need it must be impure."

[This paper, presented before the 1947 annual convention of the Am. Water Works Ass'n., is here published by permission of the Association.—Ed.]



The Author

The Balance in Present Day Chemical Treatment

Such restraint in the attitude of competent practitioners—and in 1947—represents a balancing of values and effects upon the consumer which characterizes the addition of chemicals to water. The use of chemicals in modern water treatment has brought more reasonable gains in public health to the consumer than disadvantages. These gains have been quantitative and easily demonstrable, even though each addition of a chemical to the already long list of available materials for water processing must of course be scrutinized not only by the water works man, but by the best medical and public health advisors in continuing detailed consultation with him.

Today the water works operator makes use of alum, chlorine, copper, iodine, halazone, hypochlorite, iron salts, metaphosphates, sulfuric acid, carbonic acid, sulfur and perhaps additional materials to produce a water safe and acceptable for human consumption. The exact physiological effects of each of these have not been worked out in laboratory detail. The mass results, however, of such use of chemicals certainly seem favorable. This does not mean that further observation with more refined tools of measurement may not disclose that certain cautions and certain restraints might properly be pursued in their use. But we cannot discount the beneficent experience of hundreds of millions of people throughout the world who have been drinking waters which have been chemically processed for many decades. For these millions of people, the enteric water-borne diseases have virtually disappeared.

These prefatory comments are essential to distinguish at this point between the issues which again arise in the water works industry when we come to the important and different question of using the public water supply for mass medication.

Medication

The *Oxford English Dictionary* tells us that "medicate" means "to impregnate with a medical substance." This introduces a concept which differs, no matter how slightly, from that dominating the usual application of chemicals to water. Hitherto chemical additions, with minor exceptions, have been predicated upon the correction or modification or the quality of water, with the primary intent of eliminating deleterious substances therefrom or of modifying their character in such a way as to make the commodity safer, more palatable or physically more attractive to the consumer, or softer. When we add a chemical to a water for the frank purpose of introducing a medical substance to treat the consumer rather than to modify the water, however, we enter a different area of practice.

The problem of mass medication through the water supply has arisen on several occasions in modern history. About a quarter of a century ago suggestions for such mass medication revolved primarily around the addition of iodine to water, notably at Rochester, N.Y., in order to prevent on a mass scale the incidence of thyroidism in the general public. Controversy over the validity of the use of the water supply for this purpose was high. Medical opinion on the wisdom of the undertaking was equally divided.

The experiment was tried and finally abandoned because the expenditures and the results—perhaps in addition, the disadvantages to some consumers—all indicated that it was unwise and unnecessary to meet the problem of iodine deficiencies of individuals through any such blanket medication program.

Today the same issue is revived by the fluorine "deficiency" of many of the public water supplies of this and other countries. The case history

of the proposals for the application of fluorides to water is worth detailed analysis. Such an analysis should provide the water works operator with at least some guiding principles on how he should meet these and similar proposals. These programs have already attained in this country so great a popularity that many superintendents are having a difficult time restraining the consuming public from forcing them to adopt a practice which may not be wholly supported by existing epidemiological evidence.

Application of Fluorides

The bibliographical record on fluorine and dental caries already totals hundreds of scientific papers. Interest in the studies of the relationships between this element and perhaps the most widespread of all diseases of mankind is international. The fact that relatively few persons escape dental caries puts the disease into a category in which virtually every individual in a community has an interest. The disease is not limited to any group. It attacks regardless of age, sex, geographical location or economic status. It begins its attack as soon as a child has teeth, and virtually every child of 10 years of age has at least one or more decayed permanent teeth. It is only natural, therefore, that a disease such as this, which transcends perhaps all other diseases in impact, should have been made the subject of extensive study throughout the world.

The role of fluorine in dental health has been elaborated perhaps most completely in two monographs[2,3] published by the American Association for the Advancement of Science in 1942 and in 1946. Interested readers will find in those monographs authoritative summaries of present knowledge of the relationship between dental caries and fluorine.

In the monographs the present author has reviewed the implications of the fluorine content of water with respect to these problems. The following paragraphs from this survey (4), by the present author are appropriate:

Epidemiological studies have progressed sufficiently far to indicate that the fluorides have certain protective actions against dental caries in certain age groups. In general it is assumed that an inverse relationship exists between the prevalence rate of dental caries and the fluoride concentration of municipal water supplies. Where domestic waters show fluoride concentration of 1.0 or more parts per million the incidence of caries is low. The incidence is high where such concentrations in turn are 0.5 ppm. and less.

To complicate the situation, however, an excess of fluoride frequently produces chronic dental fluorosis, commonly known as mottled enamel. The water control officer, therefore, is at once confronted with the necessity of determining the minimum effective concentration of fluorides which will produce satisfactory results without at the same time causing deleterious effects on the teeth.

So far over 20 cities have been studied in this county. In view of these studies, the question naturally arises as to why water supplies deficient in fluorine should not be promptly supplemented to such an extent as to prevent the objectionable caries effects in children of the 12-14 year age group. The findings covering now some 7,257 children continue to emphasize the marked differences in the amount of dental caries between the 8 cities whose public water supplies contained less than 0.5 ppm. fluoride and the 5 cities whose water supplies contained 0.5 ppm. or more. When these comparisons are extended from the incidence of proximal dental caries to the basis of affected tooth surfaces, the rate of the cities with the lower fluoride water supplies was about 19 times as high as in the cities with the higher fluoride content.

Within the past year additional reviews of this highly significant problem have been made by Getting, by Dean, by McClure, by Jay, by William A. Jordan and by Klein.[5-10] It is a reasonable conclusion from these many laboratory, field and epidemiological studies that the fluorine content of a communal water has a direct bearing on dental caries incidence. Up to the present time all of these studies have involved naturally fluorinated water, since the artificial addition of fluorine to water is of comparatively recent origin. Insufficient time has elapsed either to determine the effects of or to draw conclusions about the artificial addition of fluorine to water. Whether artificially fluorinated water will give the same results as water carrying natural fluorine is still an open question.

It is well established, however, that the natural fluorine content of drinking water varies inversely with the amount of dental caries. Since fluorine is a toxic element, excessive fluorine will produce mottled enamel. It should be remembered that both chlorine and iodine are also potentially toxic substances, if their uses are unscientifically controlled or are abused.

A more competent epidemiological conclusion is that something must be done to provide adequate dental care for all children. One of the answers to this problem is either the incorporation of fluorides in the municipal water supplies or its application topically and directly to the teeth. The American Dental Association has already expressed its official views that some such procedures are essential and will provide an additional technique for the solution of the enormous dental problem of this and other countries.

Table I

SOME FLUORINE APPLICATION PRACTICES IN 1947

City	Treatment Began	Chemical Form	Avg. Cost (c. per lb.)	Fluorine Content ppm. Before	Fluorine Content ppm. After	Quantity Treated (mgd.)	Control Problems	Source of Data
Brantford, Ore.	6-20-45	NaF	13.75	0.1	1.3	3.0	None	W. R. Catton
Evanston, Ill.	1-21-47	NaF	....	..	1.0	..	.....	W. H. Tucker
Grand Rapids, Mich.	1-25-45	NaF	12.68	0.07	1.0	26.0	None	W. L. Harris
Midland, Mich.	1-46	NaF	10.00	0.20	1.0	3.0	None	Paul Stegeman
Newburgh, N. Y. ...	5-2-45	NaF	8.97	0.17	1.2	3.6	None	C. R. Cox
Sheboygan, Wis. ...	2-25-46	NaF	9.42	0.15	1.2	6.0	None	J. C. Zufelt

(Figures for fluorine content before treatment at Midland, Mich., and Newburgh, N. Y., represent maximums.)

Experimental Studies

Some of the state departments of health in this country have already sanctioned the addition of fluorine to public water supplies. Without exception, however, each of these undertakings is in the nature of a mass *experiment* and *demonstration*. They are all under control observation, and none of them have been studied long enough, according to medical and dental opinion, to indicate whether or not they will perform the task for which they have been initiated without attendant objectionable results.

A summary of some of the data in the communities already applying fluorine to water is presented in Table 1. The costs attached to such an operation, at least in communities of 100,000 or less, is not a major consideration in the problem. Ordinarily

the equipment costs less than $1,000. For the most part the material is applied in the form of sodium fluoride, which costs approximately $8.00 per 100 lbs. The dose normally is approximately 1 ppm. of fluorine. The annual cost for a population of 100,000, assuming water consumption to be 100 gpd. per capita, would be about $4,500.

The approach to the development of such a program is well illustrated by the city of Evanston, Ill. In that city, the municipal health department approved the plans for the study on public health dentistry, with particular reference to the relationship of fluorine in the drinking water to the amount of tooth decay in school children. The local dental and medical societies approved the project, and the superintendent of schools agreed to co-operate in it. In addition, the city council approved the general plans on Nov. 5, 1945.

The enterprise, therefore, is a joint one of the dental clinic of the University of Chicago, the state and local health departments and the water department. The entire study was preceded by a detailed review of the dental decay situation not only in Evanston but in adjacent cities, all obtaining their water supplies from Lake Michigan. This source contains only traces of fluorine. As a result of these prior investigations, the conclusion was reached that dental decay in Evanston could be substantially reduced by adding 1 ppm. of fluorine to the public drinking water supply.

It is significant that the Evanston study is planned for a period of 15 years, and medical and dental opinion holds that at least 5 years will be necessary before measurable results even of a preliminary nature will be obtained.

A dental team completed dental examination of 4,000 Evanston children in the 6, 7, 8, and 12, 13, 14 age groups on Jan. 17, 1947, and on Jan. 21, 1947 the addition of fluorine to the water of Evanston was begun.

The application of sodium fluoride to the municipal water supply was begun in Grand Rapids, Mich., on Jan. 25, 1945. W. Leslie Harris described this practice affecting 170,000 consumers and approximately 21 mgd. of water in a recent paper[11] before the University of Michigan In-service Training Course for water works personnel. The procedures are orthodox, and the annual cost, for 1.0 ppm. of fluoride is about $11,000. The study is projected for at least 10 years and again is frankly a large-scale epidemiological investigation, the results of which await extensive parallel studies of dental caries in the young.

Aside from the communities listed in Table 1, L. A. Smith, superintendent of the water department of Madison, Wis., will shortly initiate the treatment of the public water supply of that community, using, however—for the first time in this country — hydrofluoric acid, rather than the commonly used sodium fluoride. Mr. Smith has decided upon this procedure principally because the space available for the addition of the chemical in the well structure in the Madison water works is very restricted. The individual wells feed directly into the system, and there is no central point for treatment. A dose of 1 ppm. will be used in Madison.

In addition to the applications already noted, extensive studies are under way on collateral aspects of this same problem in Massachusetts, New Jersey, Wisconsin, Minnesota and about twenty other states. In fact, the interest in this problem is so great that similar investigations are being carried out in Japan, Australia, South Africa, England, Canada and many other areas of the world. If the addition of fluorides to water becomes an acceptable process for medical and dental reasons, there are no obstacles of cost or technological problems of operation which are significant or important enough to disbar the treatment on these grounds alone. If such mass medication through the public water supply is desirable, such demonstration awaits the results of the significant control experiments already under way. Years necessarily will elapse before the findings may be considered definitive.

Evidence Lacks Conclusiveness

Most of the informed authorities, both medical and dental, insist that universal application of fluorides to waters deficient therein is not warranted upon the basis of present evidence. They consider that a reasonable number of experimental approaches on a full municipal scale are essential over a number of years to determine the values which may be inherent in such mass medication.

At the same time these groups consider that authoritative procedures for the application of fluorine directly to the teeth should be practiced in parallel with the addition to water for comparative evaluations.

Many public health authorities feel that the direct application of fluorides to the teeth of children is a more selective and more satisfactory method of controlling dental caries in the young. William A. Jordan[9] reviews these studies of topical application at length and concludes that such a procedure has many practical values not fully shared by treatment of the public water supply. It reaches many people not supplied by public water and benefits the children of today, whereas the fluorination of water cannot be expected to benefit the present generation of children unless they are very young.

To obtain some indication of the point of view of public health authorities, the author polled some 60 administrative health officers, asking whether they considered that the present evidence in this field warranted the universal application of fluorides to waters of natural content of less than 0.1 ppm. More than 90 per cent of the 60 health officers thus polled thought that nothing more than controlled experimentation was desirable at this time, in the light of available epidemiological and physiological evidence.

A similar point of view, although referring specifically to other media for the prevention of dental decay, is expressed by a recent ruling of the Council on Dental Therapeutics of the American Dental Association. The council, in considering the role of fluorine or dental caries, with special reference to synthetic fluoride tablets, concludes[12] that the mechanism through which fluorine produces a lowered caries attack is not known . . . The different tablet preparations, though probably not dangerous in amounts recommended for daily consumption, add fluoride to diets already high in fluoride content . . . may constitute a health hazard." The council declared the compounds under discussion not acceptable for inclusion in "Accepted Dental Remedies" at this time.

Guiding Principles

Since this matter is of such widespread public interest and since many water supply practitioners are literally being stampeded into the application of fluorides to water as a current procedure, it appears to the writer that a brief set of guiding principles, resting upon present information, might be useful to the water works profession. Such principles are presented herewith, not upon the basis of any personal omniscience, but on a reasonably de-

tailed review of existing practices and of professionally informed judgments.

Compliance with these principles in no sense offers obstacles to public health progress. They are merely guides to future experimentation and action. They are in complete accord with the following conclusions[13] recently stated by David B. Ast, one of the pioneer investigators in this field:

1. "Will artificially fluorinated water produce in humans the results, in kind and degree, that are caused by waters in which fluorine is found naturally? There is every reason to believe that it will, but this remains to be demonstrated."

2. "Are there any cumulative effects—beneficial or otherwise, on tissues and organs other than the teeth—of long-continued ingestion of such small concentrations as 1.0 ppm. of fluorine in water? Again, there is much presumptive evidence that there are no such effects, but, until that is demonstrated, the procedure outlined in this paper must be regarded as an investigation."

3. "Safe and practical methods of fluorinating potable water supplies must be developed and demonstrated.

"When these three factors will have been well established, as physiological conditions, then indeed will we have taken a long step in the control of dental caries."

These suggested guiding principles, therefore, are:

Principle 1. Until the periods of controlled experimentation on water have fully elapsed and the findings on those procedures and their effect upon the exposed population have been authoritatively reviewed and assayed by competent medical, dental and public health professionals, the water works official should avoid the use of the public water supply for medication.

Principle 2. Even at that time, practices for treating the diseases of the people in ways other than through the community water supply should be thoroughly evaluated from the professional and the economic standpoints. In general, such alternative practices, inherently more specific in their nature, are to be preferred.

Principle 3. Universal application of chemicals to water for medication should be predicated upon substantial unanimity of opinion by official medical and public health agencies on the efficacy of the treatment proposed.

Principle 4. A natural prerequisite to any procedure for mass medication through the public water supply is complete concurrence between the officials of the water department and those of the health department.

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DISCUSSION

J. C. GEIGER, M.D.
Director of Public Health,
City and County of San Francisco.

Dr. Wolman has made an excellent review of the subject of adding fluorides to drinking water. It is sound and based on a thorough study of the available literature. In his "Guiding Principles" he has definitely brought forth facts which should be uppermost in the minds of all concerned.

It would seem that there are already enough mass experiments and demonstrations being conducted on public water supplies and, until sufficient time has elapsed and the scientific data have been analyzed, every health officer should do his utmost to prevent pressure by the general public for treatment of drinking water supplies by the addition of fluorides. Altogether too many people throughout the United States who have heard a little about fluorides in relation to teeth are clamoring for the immediate addition of fluorides to drinking waters.

It has not been uncommon in the San Francisco Health Dept. to receive telephone calls from persons who have probably read an article in some weekly magazine on teeth and fluorine. They always want to know why something is not done in San Francisco about adding fluorides to the water supply. Their impression is that all the Water Department must do is obtain a sufficient supply of the chemical compound and shovel it into the supply. Such action, in their opinion, would remove all the evils of dental caries. Every health department should be cognizant of the experimental work now being conducted so that it will be ready to give immediate, scientific and convincing answers to these inquiries from the public.

As analyses of caries incidence may be influenced by many conditions and are dependent upon some highly subjective criteria, further work will be required before definite conclusions on the therapeutic effects of topically applied fluoride can be reached. Even if the method should prove to be effective, many questions remain to be answered before it could be generally used. Among them are: What fluoride concentration is most effective? How often and for what period should it be applied? What hazards are involved in using such a toxic substance on a broad scale? Will repeated use produce any deleterious effects on the teeth?

As Dr. Wolman has very thoroughly indicated, continued experimental practices must be conducted with the sanction of the medical and dental professions, under the close supervision of water works engineers and public health authorities, and in conjunction with institutions recognized in this field of endeavor.

W. C. MORSE
Sup't., Water Dept., Seattle, Wash.

This writer wishes to grasp the opportunity to discuss for a moment the very splendid paper just delivered. It is a long time since he has had the pleasure of seeing an idea

which he thoroughly believes in so clearly expressed.

About forty years ago, at a dentists' convention, this writer heard a dentist insist that, if Seattle continued to use Cedar River water, at the end of two generations children would be born without either bone or tooth structure.

It is true that Seattle's Cedar River water is somewhat deficient in lime, having only 6 ppm., but the fact remains that this alarming second generation has arrived, and with bone enough to sweep the crew races of the nation on the Hudson at Poughkeepsie. Furthermore, at the age of 73, the writer still has his own teeth.

Of course, no one knows what effect Seattle water would have on those moving to the city, but they are invited to live there for 65 years to find out. Anyway, the persistent campaign for the addition of lime to Cedar River water finally died.

About 30 years ago a tremendous furor was raised, not only in Seattle but in many parts of the nation, for the introduction of iodine in various forms into the water, to overcome the tendency toward goiter, but that movement was short lived as other more practical methods of supplying iodine to those needing it were adopted.

Now water works men are faced with a demand that fluorides be introduced into the water supplies of various towns and cities. At present there is less known of the therapeutics of the chemical fluorine than there is about those of most other chemicals. In other words, its effects upon the system are not well understood.

Every individual has a different chemical make-up and, in consequence, a different chemical demand. Dental caries seems to be stopped by water carrying from 1 to 1.55 ppm. of fluorides; but it is also true that, immediately above that amount, the action of the chemical causes mottling of the tooth.

It should be emphasized that if water treated with fluorides is continuously served to an individual already carrying an amount approaching the tolerance maximum, mottled enamel might result, with the ready possibility of suits against the city and the water department management for damages.

Personally, the writer believes that it is not good judgment, where safety is not involved, to treat 100 gal. of water for the sake of the 1 gal. used for human consumption. The Seattle Water Dept. would not be willing to medicate its water supply until such action was fully and unanimously recommended by the U.S. Public Health Service, the State Health Dept. and the City Health Dept. Until such time, water supply men should move with much caution and little haste.

Water Works Service Company Engineers Retire

On June 30th, G. W. Biggs, Jr., and F. R. Berry, Vice-Pres. and Chief Engr., respectively, of the Water Works Service Company, New York, retired after nearly 50 years service.

G. W. Biggs

Blank & Stoller

F. R. Berry

The careers of these two men parallel a large part the history of the company which they saw grow from a nucleus of 30 plants to its present 69, and from less than 2,000 miles of mains to more than 8,000.

Rigdon Berry joined the company, then known as the American Water Works and Guarantee Company in 1899 in Pittsburgh, and his first job was at St. Joseph as a time-keeper on the construction of its first settling basin.

Mr. Biggs became Chief Engineer in 1906. In 1914 the company became the American Water Works & Electric Co., and the main office was moved from Pittsburgh to New York. In 1944 the Water Works Service Company was formed, of which Mr. Berry became Chief Engineer, and Mr. Biggs Vice President and Director.

Sludge Digester Tank Loadings

(A Correction)

At the meeting of the Michigan Sewage Works Assn. held in Jackson, Mich. in May of this year, W. F. Shephard, Chief of the Sewage Division of the Michigan Dept. of Health, proposed a new unit or new basis of reporting sludge digestion tank loadings. In our report of that meeting on p. 261 in the July number of *Water & Sewage Works*, Mr. Shephard's proposed basis was erronously presented.

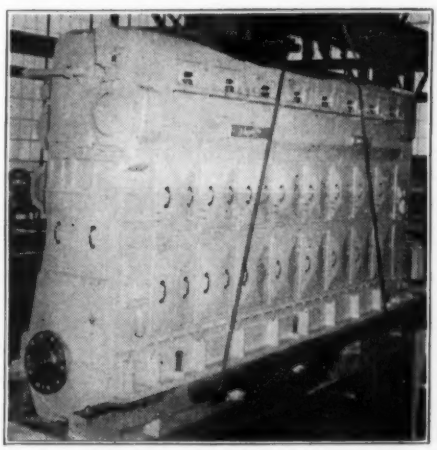
Mr. Shephard proposes that to improve the standardization of terminology, the unit basis of digester loading should be *cu. ft. capacity per pound of volatile matter added daily.* (We reported that the unit proposed was lb. vol. sol. per cu. ft. per day). Mr. Shephard proposes on the basis of a study of Michigan plants that for primary sludge digestion, the capacity of the tank should be 30 to 35 cu. ft. per pound of volatile solids to be added daily. In the case of activated sludge, 25 to 30 cu. ft. per pound of volatile matter daily seems to be the limit.

Mr. Shephard writes, "I like this method of calculation because the load of solids is usually calculated first and then a simple direct multiplication gives the required volume."

Whenever the capacity available drops below these limits for each pound of volatile matter added daily, then the supernatant liquor will deteriorate and tendencies to foam will develop.

Havana, Cuba, Sewage Plant to Use Diesel Power

The accompanying photograph shows the first of three large Diesel engines being shipped to Havana where it will be installed in the Casa



Blanca Pumping Station of the Cuban capitol's sewage disposal system. The engines were constructed by the Superior Engine Division, National Supply Co., Springfield, Ohio.

Two of the diesel engines are 8-cylinder generator sets with 960 rated horsepower at 360 ppm.; the third is a 6 cylinder 720 hp. model. Installation is being made by Senor Antonio Gil, Havana contractor.

LABOR SAVING THROUGH DUPLICATING WITH MODERN EQUIPMENT

Also of Great Value for Reproduction of Old or Damaged Tracings, Maps, Records, etc.

By W. R. LA DUE
Supt. and Chief Engineer
BUREAU OF WATER AND SEWERAGE
AKRON, OHIO

DURING periods of shortages of professional and technical personnel, whether general or of a local nature, engendered by low salary rates, many relatively new mechanical methods and procedures, if adapted to a particular organization, can relieve to a certain degree the lack of manpower. The Akron Water Works experienced this shortage in professional and stenographic classifications, and reacted accordingly.

The Author
(Past Pres., A.W.W.A.)

The duplicating equipment, previously utilized, consisted of a proverbial "one-horse shay," a 54-inch, continuous-operating, 6-arc light blueprinting machine, of 1925 vintage, with gas heated attached dryer, and a hand operated mimeograph machine of a slightly younger age. Both had served long and well, but were worn out and needed replacing. Rather than replace in kind, a study was undertaken to ascertain what new and improved equipment was available to perform the required work better and more expeditiously, and to lighten the load on our under-staffed force.

Equipment Selected

The field was surveyed from the simplest copying machine to the photo-reproduction of the photostat and similar equipment. After careful study of all types of equipment and the uses to which they could be put, the decision was made to replace the existing equipment by securing:

(a) An electric-driven Multilith Duplicator, having a capacity of 6,000 impressions per hour.

(b) A 42-inch Ozalid Ammonia Mercury Vapor Printer of the non-continuous printing and developing type.

(c) A Hunter Copyist Machine with a 30-inch by 42-inch printing surface, together with the necessary developing trays and electric dryer.

The first cost of these three pieces of equipment compared favorably with the cost of replacing the 54-inch continuous, blueprinting machine. This group of equipment has handled all the duplicating needs peculiar to the clerical and engineering divisions of our water works, with the exception of enlargement or reduction requirements. The small amount of photographic enlargement or reduction required did not seem to warrant an expenditure for this type of equipment at this time.

The Multilith Duplicator
(6,000 *Impressions per hour*)

The Multilith

The Multilith is an offset-type, duplicating machine, utilizing paper or metal mats for the direct preparation of the duplicating medium by means of ink, crayon, carbon or ribbon, utilizing typewriter, writing, sketches or drafting and photographic etchings. Various grades of paper mats permit an economical selection to be made based on number of copies desired. The metal mat (also one type of paper mat) is reusable, but the metal mat permits the making of more copies than does the paper mat. A photographic service for preparing etched mats is maintained by the manufacturer, making the purchase of costly photographic cameras and equipment optional. Our volume could not justify this expenditure.

Paper, size 3-inch by 5-inch to 9½-inch by 14-inch in standard finishes, color and weight, can be mechanically fed and counted. An automatic ejector permits only single sheets to be fed and counted. Many colors of ink are available and can be quickly changed. Hair line feeding permits the duplicating of multi-colored work and the production of forms in several colors for multiple-copy usage.

Ozalid Prints

The prints from this modern, ammonia-developing, process printer have proven very satisfactory for our needs. White background prints with blue, black or brown lines are possible, as are prints on transparent or translucent mediums for reprinting. Prints made by this process are available for use at once, which is not

possible in the ordinary wet process. This advantage constitutes an important consideration in emergency work. However, one point must be considered. In case the printer has been shut down, it cannot be started again for some 15 minutes. In ordinary operations, however, this is not of vital importance.

Hunter Copyist

The Copyist method of reproduction comprises a direct contact, photographic process requiring subsequent wet developing. It is most useful in the engineering section, being capable of making prints (and negatives), suitable for subsequent use on the Ozalid Printer, from blue prints, old tracings, or even pencil drawings and sketches. Likewise, reproduction of letters, records, or abstracts from books can be made and duplicate copies made either on the Hunter Copyist or on the Ozalid Printer.

Results

The operation of this equipment is under the supervision of our engineering section. It is believed obvious that the operator of these three items (one employee handles all three) is not the ordinary "blue print boy" of the engineering office, but a skilled operator in a semi-technical field.

The equipment was purchased primarily as a water works asset but other city departments have recognized its value and a considerable percentage of the work performed is now for other city departments.

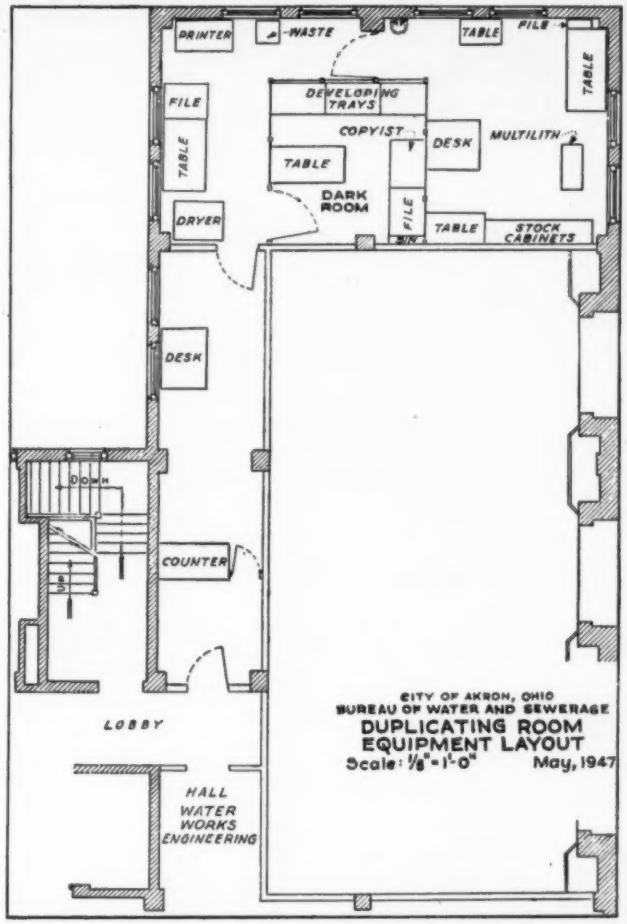
Although an accurate measurement of savings of time or money, resulting from the use of these newer methods and machines, is impossible, suffice it to say that interlocking features have permitted the performance of more and better work. Each piece of equipment has a field of its own in the production of a quality low cost item. A co-ordinated utilization of each piece with the other two has produced some hereto, unthought-of results in production and economy.

A major saving to manpower has enured to the various engineering sections of our city. Plan and plat preparation has been expedited to a degree not previously thought possible. Much of the expected loss of volume, due to lack of engineers, was recaptured by intelligent planning and use of this mechanical equipment.

New ideas are developed almost daily, each with its own peculiar saving. A few follow:

1. In order to revise an old tracing, the portion to be changed was blocked out, a new tracing (cloth or paper) made on the Hunter Copyist, changes were made in ink and prints therefrom prepared on the Ozalid. Patches made on original tracings do not show up in the reproductions.

2. To develop an engineering study, negatives were made on the Hunter Copyist from a blue print, an old and a current tracing, sections cut from these negatives and taped with transparent tape forming a new negative from which prints were made.



Plan and Arrangement of Duplicating Room, Akron Bureau of Water and Sewerage

3. Typing in stages, coupled with paper tracings made on the Hunter Copyist, permitted the making of twenty-seven (27) different rate charts with typing equivalent to only three complete charts. These in turn were printed on chart film for permanence, using the Ozalid for such reproduction.

4. A combination of two record forms, used to develop a new one, were photographed on the Hunter Copyist, the print used for the preparation of an etched plate and duplicated on the Multilith.

5. To provide flexible mailing, and a message to the consumers, the image of the postage indicia is placed on a mat by means of a rubber stamp. Then the message and caricature of "Willing Water," prepared by a draftsman, are both simultaneously duplicated by means of the Multilith on the address side of the water bills.

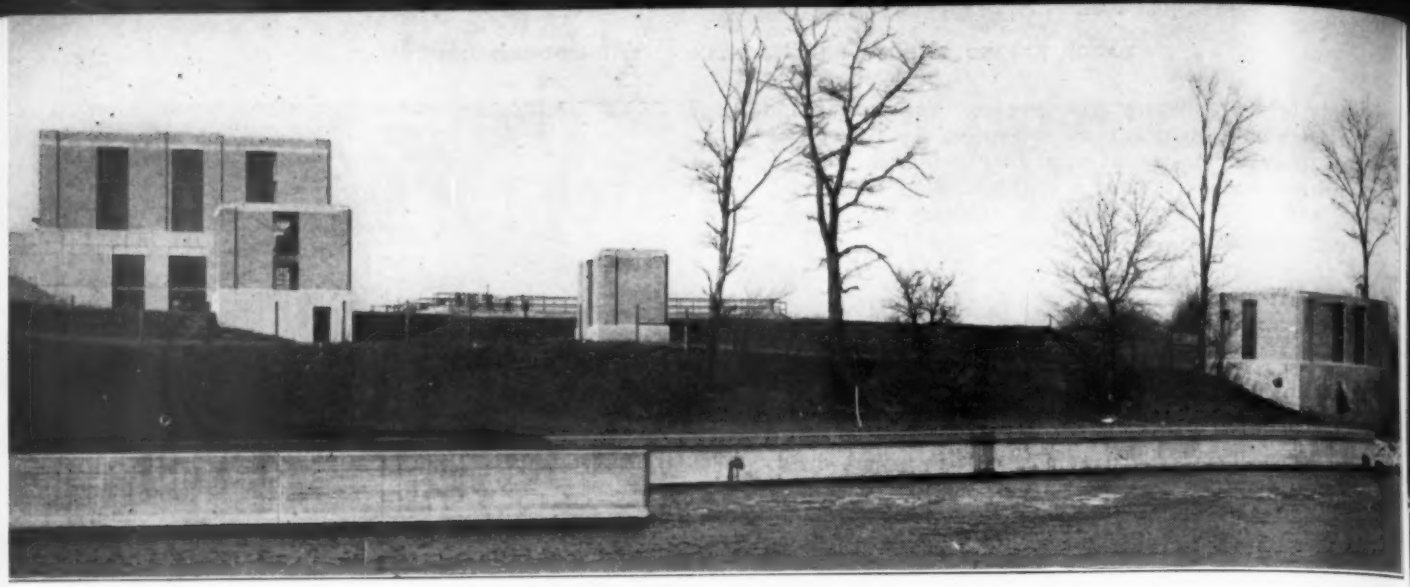
In the development of our new Duplicating Section, we feel we have engineered well and purchased wisely.

Kansas Water and Sewage Associations' Officers

The recently organized Kansas Section of A.W.W.A. and the Kansas Sewage Assoc. both elected officers at their joint meeting in Wichita. Chairman of the A.W.W.A. section is E. J. Allison, city manager of Salina, Kans.; Vice Chairman is H. H. Kansteiner, sup't. of production and distribution of Leavenworth, and Major Hagar, water sup't. of Lawrence, is secy.-treas.

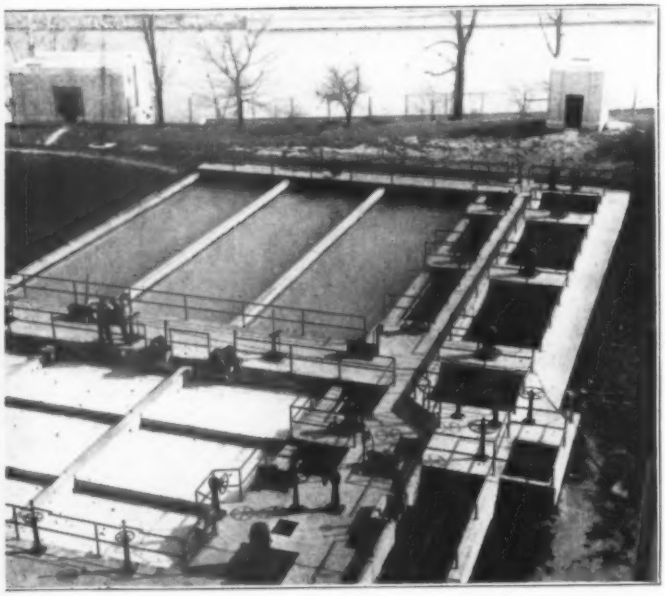
The Sewage Works Assoc. elected the following officers: Neal F. Harr, city engineer of McPherson as chairman; R. M. Lindsey, sup't. of gas plant of Humboldt, as vice-chairman; and Ben L. Williamson, chief engr., div. of sanitation, State Board of Health as secy.-treas.

The Kansas Section of A.W.W.A., which was formed by withdrawing some 22 members from the original Missouri Valley section, has now grown to 100 members.



THE WILLOW RUN WATER SOFTENING PLANT

By NICHOLAS HERDA
Supt. of Utilities
KAISER-FRAZER CORP.
WILLOW RUN, DETROIT, MICH.



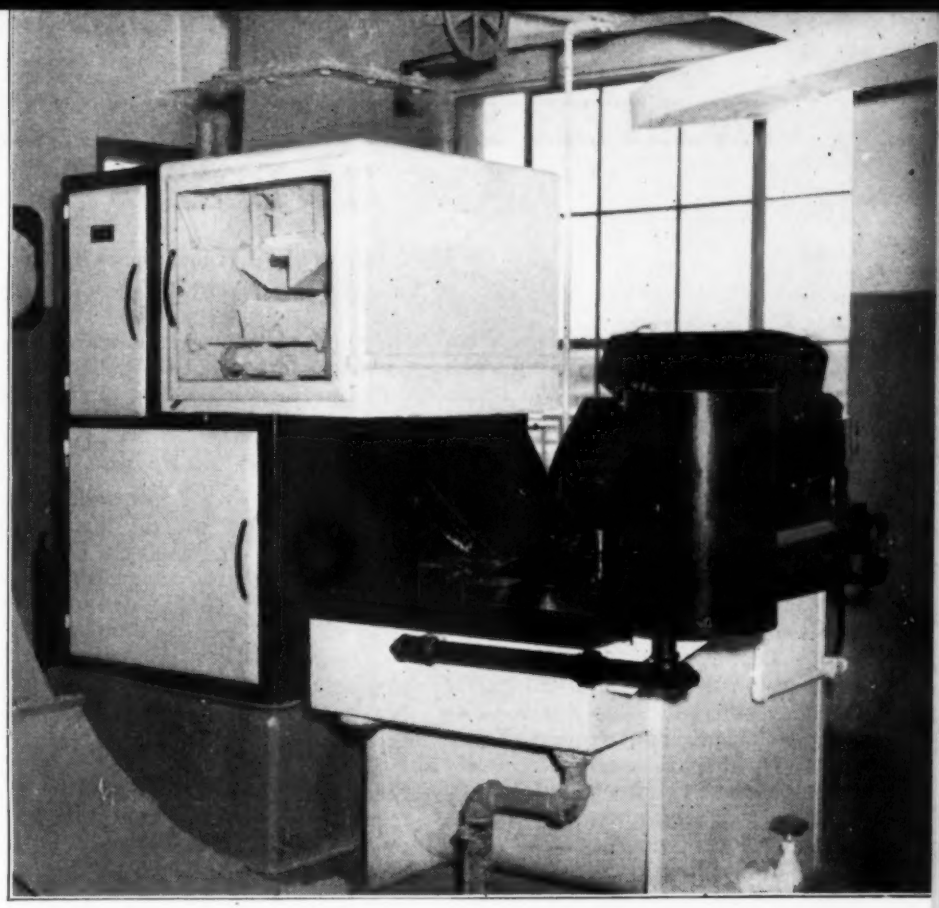
Located on the scenic bank of the Huron River, the water softening plant of the famous Willow Run manufacturing plant now serves the Kaiser-Frazer Corp. Built in 1943 for the former bomber plant and with a capacity of 6 mgd., the source of supply is three wells, 84 ft. deep, or the river itself. In either case softening is necessary. The present output of the plant is 2.8 mgd.

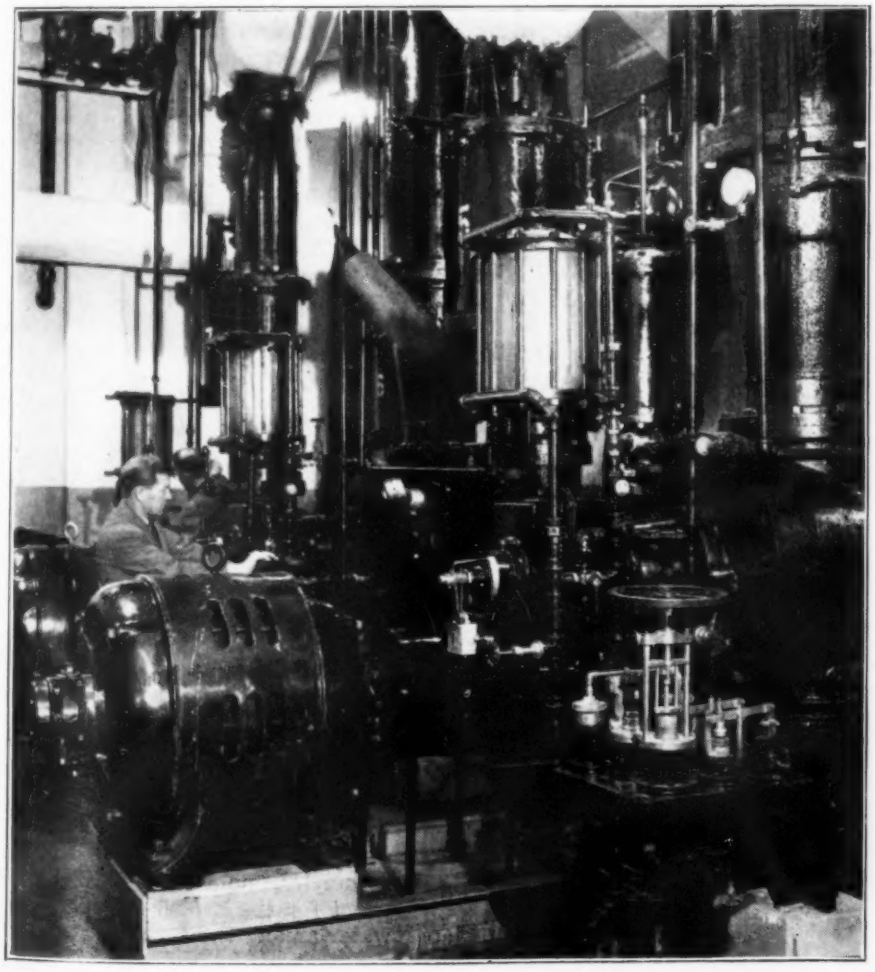
The main building, shown at the left of the top photo contains five stories, with the pumps on the first floor; six rapid sand filters and chemical feeders on the second; lime conveyor, switchboards, CO_2 furnaces, locker rooms, etc. on the third; laboratory, chlorine room, back-wash water tank, and chemical bins on the fourth; and bulk chemical storage on the fifth floor.

Behind the main building (see photo to the left) are three primary and three final settling basins and six flocculating basins.

Pre-chlorination after aeration is at a 2 ppm. dosage and post-chlorination after filtration is at 1 ppm. dosage. Both 105 lb. and ton chlorine containers are used. Approximately 70 lb. of chlorine are added per day. Residual chlorine is maintained at 0.75 ppm. as the water leaves the filter plant and at 0.5 ppm. at the manufacturing plant 2½ miles away. [In the photo at the left, the author is shown adjusting the chlorine feed. —Ed.]

Lime and soda ash are added from dry feeders located on the second floor. The photo at the right shows an Omega lime feeder and slaker. Approximately 1800 lb. of lime are added per mil. gal. treated, whereas soda ash is only infrequently used as the non-carbonate hardness of the well water is only 25 ppm. Split treatment is employed; 75 per cent of the water being overtreated and mixed with 25 per cent of raw water. Some of the precipitated sludge is returned to the incoming raw water to aid the softening reaction. Recarbonation with CO_2, produced in special oil burning furnaces, prevents after-precipitation and stabilizes the water. The total hardness is reduced from an average of 279 ppm. to 64 ppm.





Three high lift service pumps located on the first floor of the main building maintain pressure in the distribution system which supplies the 407,000 gallon elevated tank at the manufacturing building nearly 12,000 ft. away.

Other equipment located in this room include two river water pumps (the well pumps are located in the well houses near the bank of the river), three sludge pumps and valves and piping for the filters.

In addition to lime and soda ash for softening and chlorine for disinfection, 250 lb. of activated carbon are used per mil. gal. to remove tastes and odors when river water is used. At present, the wells furnish the entire supply.

WATER SUPPLY AND LEGISLATION IN BRITAIN

By R. C. S. WALTERS, D.Sc., M.Inst.C.E.
LONDON

LEGISLATION with regard to water rights in Britain has grown up mostly as the result of circumstances. It is haphazard and has been carried out piecemeal. In the old days there were fewer demands, fewer people, and life was less complicated. Everybody obtained their very small requirements of water at their own doorsteps. But even as far back as the year 1200, seven hundred and fifty years ago, people began to go further afield. Thus we read of how the old monks of Gloucester had to go a mile or so away to obtain water from a spring. In 1357 a dispute concerning water arose between two groups of Friars. The then reigning king, Edward III, sent his eldest son to give each the right of leading water in leaden pipes of equal size.

Early Water Piping Charters

During the Middle Ages, piped supplies of water were provided under powers conferred by charters such as that for Southampton in 1420, Hull in 1447, and Bath in 1500.

In the 17th and 18th centuries, several places, including London and Oxford, obtained special acts, but it was not until 1840, when there were serious typhoid and cholera epidemics, that Parliament set up a Select Committee of the House of Commons because the "water supplies of the masses" were insufficient. In 1843-1845 the first Royal Commission sat to inquire into the "state and prevailing conditions of water supplies." They found that only 8,000 out of 40,000 houses in Birmingham had water laid on, and at Bristol only some 5,000 out of 100,000 people had water in their houses.

First Water Supply Acts

The findings of this important commission resulted in several Acts of Parliament—the Water Works Clauses Act of 1847, and the Public Health Acts of 1848, 1863, 1875, and 1878. The 1847 Act makes special provisions for water companies, and the 1848 Act empowers local authorities to furnish water supplies.

The main provisions of these Acts covered the construction of water works, providing compensation for loss and damage to property which might occur in developing resources and constructing works, laying pipes, and the like. Water supplies were to be "pure, safe, and constant," and of sufficient pressure to reach the top of the highest house.

Procedures of the Present

Today powers for additional sources of water and for the protection of water supplies are obtained by Act of Parliament, or alternatively by an order from Britain's Ministry of Health to be confirmed by Parliament. The water authority or company promoting a Bill puts all the works of detailed procedure in the hand of a Parliamentary agent.

Every private Water Bill to which there is opposition is judged by five members of the House of Commons or five Peers of the House of Lords. The scheme is explained by the leading Counsel of the Parliamentary Bar, and witnesses, engineers, geologists, financial experts, are called to explain its merits. These witnesses are subjected to cross-examination by the Opposition, and Counsel for the Opposition sets out its objections against the scheme supported by the evidence of expert witnesses.

Opposition to taking water from a river, whether by means of a dam or simply by a river intake, comes chiefly from the landowner who may not want to sell his land for the reservoir or from the owners of the river banks. Everybody twenty miles downstream of the intake or dam has the right to oppose. The question is how much can be taken for the water supply of a city or town and yet leave enough in the river for mill-owners who use the water for power or for driving corn-mills; for industrial people who use the water for cooling or for driving turbines for power and lighting; for silk manufacturers who use water for dyeing and silk processing; for the woolen and cotton industries, or farmers who need water for watering cattle and crops.

Regulation of Water Takings

It is a frequent practice to allow a water authority to take two-thirds of the average flow of the three driest consecutive years in the stream, provided it guarantees one-third of this flow shall be maintained.

Opposition to the acquisition of a new site for abstracting underground water by establishing a pumping station, and for digging a well, resolves itself into the question of whether other wells or springs are going to have the water taken away from them. Any individual or manufacturing firm has the right in this country to sink a well on his own property and to withdraw all the available water that can be taken for his own use, provided they do not sell the water to anyone else. This power is without regard for any resultant effects on neighbors' wells.

Under London there has been a "Battle of Wells" for many years. The water level has been drawn down during the last sixty years from a few feet below the surface to over 200 feet. As soon as the water gets out of the range of a pump in one well, the pump is lowered, and as likely as not the continued taking dries up the neighboring well.

Legal Position of Public Supplies Most Unsatisfactory

Recently it has been felt that the legal position of public water supplies in Britain is unsatisfactory in many ways, and it is probable that in the future the law will be simplified. It is likely that nobody, whether he be a private individual, a firm, or a public authority, will be allowed to sink a well without some kind of license, as it is manifestly unfair that a private firm has the right to deplete the ground water supply of a waterworks, but a waterworks is penalized if it depletes a well of a private firm. There ought, therefore, to be more protection for Britain's public water supplies.

In addition, although a Water Bill may be approved by one Ministry, such as the Ministry of Health, which is concerned with the water supply of a town, the same Bill might be adversely reported upon by the Ministry of Agriculture, which is concerned with looking after the rural areas; or opposed by the Ministry of Town and Country Planning on the grounds of the works being unsightly; or by the Ministry of Transport as interfering with communications.

Difficulties such as these need straightening out, and some guiding principles, no doubt, will be laid down for the proper distribution of water among the several interests.

HYDRAULICS FOR THE PRACTICAL WATER WORKS MAN

The Eleventh of a Series of Articles

Flow Measurement by Use of Weirs*

By ROBERT W. ANGUS, M.E.
Consulting Engineer
TORONTO, CANADA
(*Professor Emeritus of Mechanical Engineering, University of Toronto*)

SINCE the problem of measuring the discharge has already been introduced it might be well to finish the matter at the present time. Various devices in closed pipes and the orifice in an open tank have already been discussed, but the orifice is rarely used in the latter way for measuring large quantities of water, mainly because of the practical difficulties attending its use. For instance, a large orifice involving a large tank would be necessary and it would have to be deep to provide for a high head on the orifice. This makes the arrangement inconvenient and expensive, and it is difficult to avoid eddies in the tank with the large flows. For these reasons large discharges are frequently measured by *weirs*, certain forms of which are often suitable for small discharges.

The Author

Rectangular Weirs

One of the most common forms of this device is the rectangular weir, shown in place in a flume in Fig. 38. In this case a dam has been placed across the flume and in it has been cut a rectangular notch, or weir, as it is called, through which the water flows, the depth of water above the horizontal edge or crest being clearly a measure of the discharge. In using the device for measuring, the edges are always made perfectly straight and smooth, with the crest perfectly level and thin, and the upstream face of the wall and weir must be very smooth with no projecting parts of any kind.

Weirs are sharp-crested, which means the same thing as square-edged in the case of the orifices already described, and the crest must be kept well above the bottom of the channel. The accuracy is very much improved if the "height" **p** is kept at least three times the depth of water on the crest, and it is better to exceed this proportion where possible. As shown on the upper diagram of Fig. 38, the stream has contractions on the lower side as well as on both ends and is referred to as a weir with end contractions, or a contracted weir; this is probably the most common arrangement. The vertical edges must be at least a distance **H** away from the walls of the tank.

Another arrangement, shown on the lower diagram of Fig. 38, has vertical, parallel walls above the weir so as to guide the water to it and thus prevent the end contractions without interfering with that at the bottom. This weir is described as one with end contractions suppressed or a suppressed weir and, naturally, the discharge over a suppressed weir will be

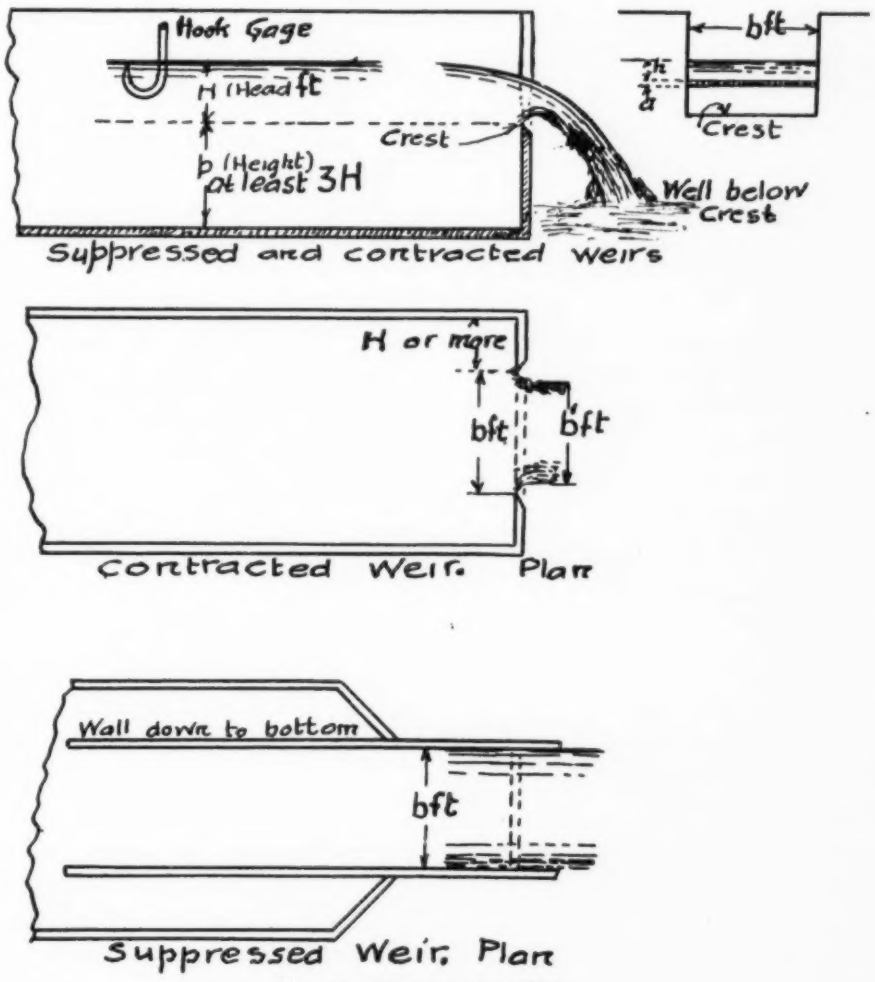


Fig. 38. Rectangular Weirs

*The reader is referred to two nomographs on weir discharge (rectangular and 60° and 90° V-notch) which appear on pages R-272 and R-273 in the July, 1947, number of *Water & Sewage Works*.

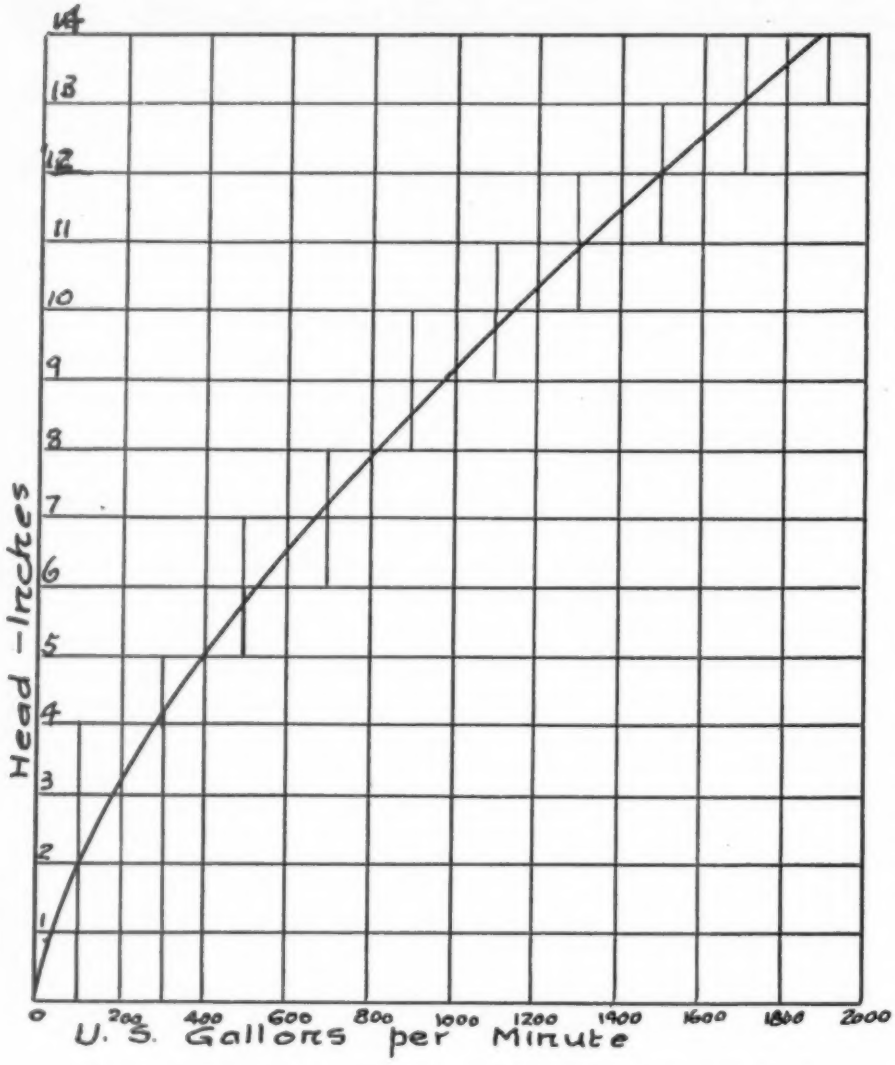


Fig. 39. Discharge From Suppressed Rectangular Weir, 1 ft. Long

(For suppressed weirs, multiply the curve value by the length of weir in feet.—For contracted weirs multiply the curve value by the weir length in feet minus one-fifth of the head in feet.)

greater than that over a contracted weir of the same length **b** and with the same depth of water **H** over the crest.

There is little to choose between the two forms, as both are equally accurate and convenient for the measurement of large flows in streams and from pipes, and they are often used to measure sewage and fluids of that kind. If errors of a few per cent are not serious, the device is easily set up, but where great accuracy is desired, much care is necessary to see that the water flowing toward the weir has no eddies in it and that the flow is evenly distributed over the entire crest; also that the flow approaches the notch in straight lines normal to the face of the weir, conditions very difficult to carry out in practice.

In all cases baffles must be arranged above the weir to remove all turbulence and to make sure that the water in the approach channel will be evenly distributed, without eddies, and with a smooth surface. Whatever arrangement is used, the water on the downstream side must be at least eight inches below the crest. Rectangular weirs have been made up to 100 ft. or more in length and sometimes have a depth exceeding six feet on the crest, but they also go down to lengths rarely under one foot, with depth of water usually over two inches over them. Their range of usefulness is obviously very great. For the shorter weirs it is good practice to limit the head **H** to less than about one-quarter of the length **b**.

It is not desirable here to enter into a discussion of the very extensive investigations that have been made on weirs, as these are of little practical value to water works men, although such studies are necessary where a high degree of accuracy is desired. The theory will, therefore, be explained very briefly by reference to Fig. 38, where a very small strip of the stream is shown hatched; its height is **a** ft., which is very small, its length **b** ft., and its area is **ab** sq. ft., if there is no contraction at the ends, as in the suppressed weir; but if there is end contraction, the effective length is less than **b** and the effective area must be corrected accordingly. In introducing the matter, the suppressed weir is being considered. From previous discussion on velocity and velocity head, the velocity through the little strip is $\sqrt{64.3\,h}$, where **h** is the depth of water on the strip, measured in feet. The volume of water flowing through this strip is proportional to $ab\sqrt{64.3\,h}$, and if the whole depth of water on the crest is divided into similar strips, the total discharge is the sum of the separate discharges through the individual strips.

But all the strips have the same length **b** and the sum of all the small heights **a** is **H**, the total depth of water on the crest, and if all the small discharges through the separate strips are added together to give the total discharge, the latter will be expressed in a formula like $Hb\sqrt{64.3\,H}$ multiplied by a number which will take account of friction and end and bottom contraction as it occurs. It must, however, be observed that the velocity through the various strips varies greatly, that of the top strips being much lower than that of the strips near the crest, and that the formula just quoted gives the discharge as proportional to the area of the water **bH** at the weir, multiplied by the velocity $\sqrt{64.3\,H}$ at the crest, whereas it should be multiplied by the average velocity. It is not desirable here to give the mathematical discussion which shows that the average velocity is two-thirds that at the crest.

Friction and contraction have an effect similar to that in the orifice and reduce the discharge to about 62.3 per cent of what it would be if these were absent. (The coefficient of discharge for the orifice has already been given as 0.61, which corresponds with the 0.623 for the weir where a slightly higher result would naturally be expected.) The discharge for the weir would then be given by

$$Q = \frac{2}{3} \times 0.623bH\sqrt{64.3\,H} \text{ or}$$

or $Q = 3.33\ bH\sqrt{H}$ in cubic feet per second. Both **b** and **H** are in

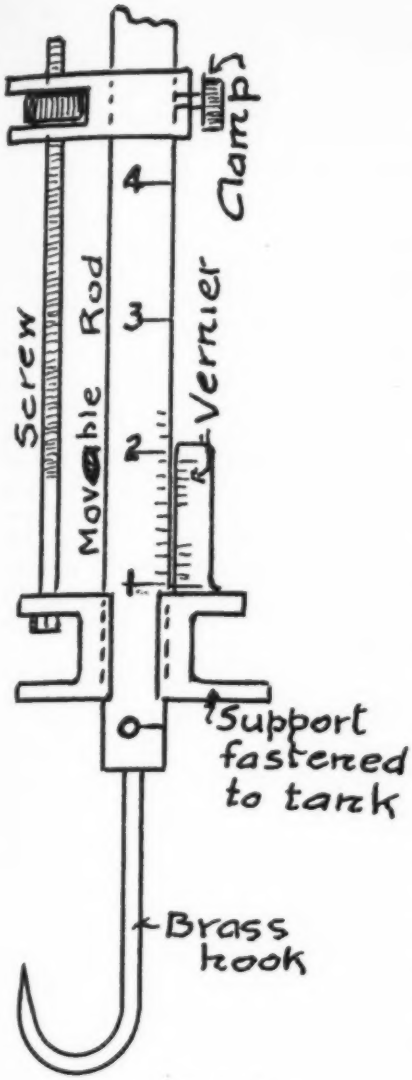


Fig. 40. Hook Gage

feet. Literally thousands of experiments have been made on weirs, one of the first extensive series being made by Francis at Lowell, Mass., nearly one hundred years ago, where he had a way of catching the flow in a large reservoir and measuring it directly. He compared the measured discharge with that calculated from the above formula and found a remarkably close agreement for suppressed weirs provided the bottom of the approach channel was at least three times H ft. below the crest, but for smaller distances (heights) the formula had to be modified. Francis also found that the same formula would apply to contracted weirs provided the length b was replaced by $b - \frac{H}{5}$ and these formulas $Q = 3.33\,bH\sqrt{H}$ for suppressed weirs and

$$Q = 3.33\left(b - \frac{H}{5}\right) H\sqrt{H}$$

for contracted weirs are called "Francis formulas." The discharge is in cubic feet per second and both b and H are to be in feet.

The writer is quite well aware of the defects in these formulas and that they would not be used in such accurate work as turbine and pump testing, but such highly precise work must be done by an expert in any event. The formulas have been largely used for ordinary work where an error of perhaps two per cent is not serious; they are very simple and easy to work out, a fact which gives them great merit. For a weir 10 ft. long with a depth of 18 in. on the crest ($H = 1.5$) the discharge would be $3.33 \times 10 \times 1.5\sqrt{1.5}$ or 61.2 cu. ft. per sec. for a suppressed weir and $3.33(10 - 0.3) \times 1.5\sqrt{1.5}$ or 59.3 cu. ft. per sec. for the contracted weir. These results are close if the crest is at least 4.5 ft. above the bottom of the channel and there are no serious eddies upstream.

As a check on calculating the discharge by these formulas, the curve shown on Fig. 39 has been prepared. It gives the discharge over a suppressed weir one foot long for different heads in inches, the discharge being in U. S. gallons per minute. The crest is assumed to be at least a distance of three times the head above the bottom of the tank or flume. To get the discharge for any other length of weir it is only necessary to multiply the value taken from the curve for the given head by the length of the weir in feet if it is a suppressed one, or by the length of the weir in feet less one-fifth of the head in feet if the weir has end contractions. As it is hard to read the curve with great accuracy, it will generally be advisable to work out the discharge by the formula as well.

The head H must be measured in feet at a distance of at least three feet upstream from the weir, so as to be in the level part of the water surface, and it is very frequently taken by a hook gage of the form shown at Fig. 40. This type of gage is used because it is easy to see when the point of the hook breaks through the water surface. If the latter is perfectly smooth, this break through can easily be detected for a movement of the hook of less than one one-hundredth of an inch so that very accurate setting of it is possible. The movable rod to which the brass hook is attached is equipped with an adjusting screw which facilitates the matter and the vernier enables very close readings to be made.

The zero reading on the rod may be found by means of a level by which the hook may be set level with the crest, but a more accurate and easy way is to fill the space above the weir with water till it is just level with the crest and then set the hook to suit this level and take the reading. Great care is necessary in fixing the water level because the surface tension of the water enables it to stand slightly above the crest without running over. Sometimes it is necessary to surround the hook with a stilling box placed in the water so that the top of it comes above the surface and made with a half inch hole in the bottom, so that oscillations will be damped out, but the water in the box will be level with the average water surface.

V-Notch Weirs

Rectangular weirs are rarely less than one foot long and are not, therefore, used for measuring very small flows. Where an orifice is not convenient, the V notch is often employed and is suitable for discharges of from around 10 to more than 3500 gallons per minute, although for the upper limit other measuring devices are more common. This weir is shown in Fig. 41 and is just a notch of triangular shape cut in the vertical wall of a dam or tank. It is sharp edged as in the case of the rectangular weir and the angle at the vertex varies from 90 degrees in the right angled V notch to quite small angles where the flow is small. The notch may be

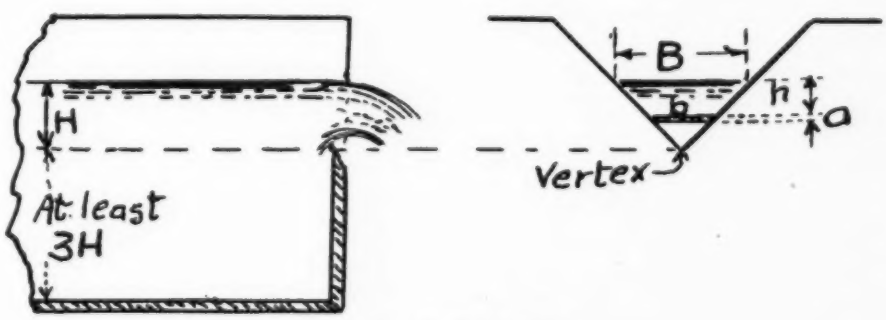


Fig. 41. V-Notch Weir

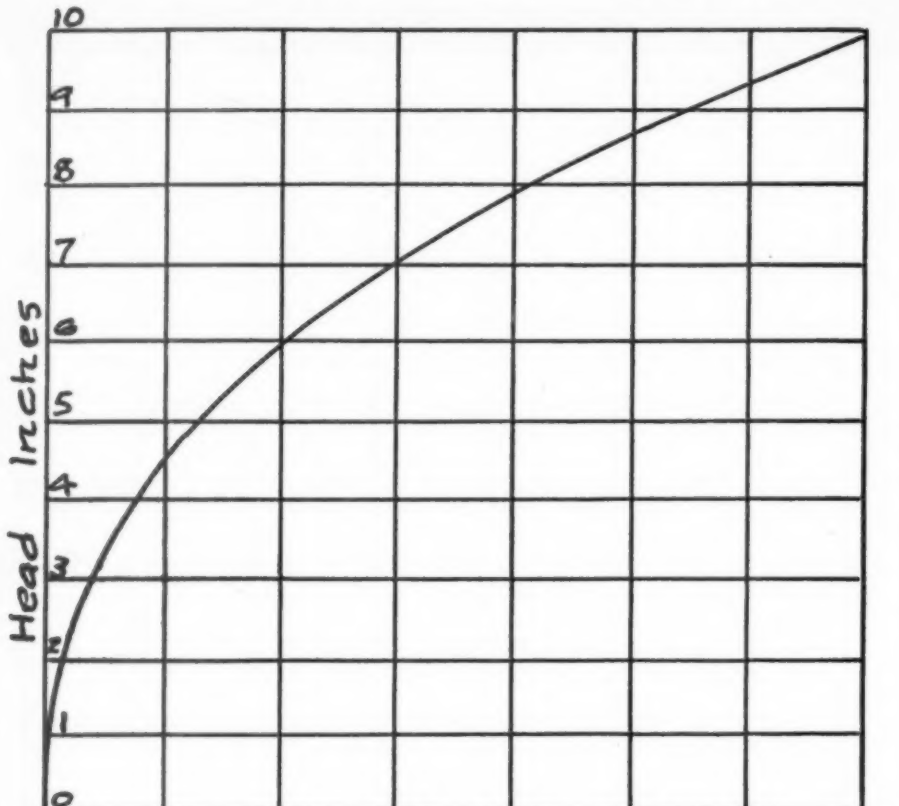


Fig. 42. Discharge Curve for Right-Angled V-Notch Weir

cut in a smooth brass plate, but boiler plate or cast iron is often used. Since the latter two materials are not so smooth as brass, they tend to decrease the contraction of the flowing jet and usually give a greater discharge for the same head than the brass one does. Whatever metal is used, the face of the metal must be kept free of grease, paint, dirt or rust, particularly close around the edges of the notch.

As in the case of rectangular weirs, it is only possible to give an outline of the theory applying to the V-notch weir, and a reference to the drawing showing a longitudinal section and a front view will indicate the terms used. The small horizontal hatched strip has the length **b**, the small height **a**, and is at depth **h** below the water surface. The discharge through this small strip is $ab\sqrt{64.3\,h}$ multiplied by a factor to correct for end contractions and for friction. But the length **b** of each horizontal strip is proportional to **h** and consequently the addition of the discharges of all these strips making up the entire area above the crest will be proportional to $H^2\sqrt{64.3\,H}$, as is easily shown by mathematics. The formula used for the notch is $Q = cH^2\sqrt{H}$, where **c** is a coefficient taking account of friction, contraction and also the number $\sqrt{64.3}$. For the right-angled V notch **c** varies from 2.55 for a head of 0.25 ft. to 2.49 for 0.85 ft. head where the notch is in clean brass plate, but if a surface of about the same smoothness as clean, rust-free boiler plate, then **c** varies from 2.63 for the lower head to 2.48 for 1.8 ft. head, according to King's Handbook of Hydraulics (McGraw-Hill Book Co.) An approximate average value of 2.5 would be from 2 to 5 per cent low on the low heads and very close on the higher ones. The curve in Fig. 42 will be found useful and is for a weir cut in a plate of similar smoothness to boiler plate, the notch being right-angled.

The vertex of the notch must be at least three times the head away from the sides and bottom, and the same precautions must be taken as with the rectangular weir in damping out eddies, etc. For the 90-degree notch the breadth **B** is equal **2H**, but for measuring small flows such as feed water and chemical solutions, **B** is often made much smaller with the angle at the vertex less than 90 degrees. While it is possible to say, *very roughly*, that the discharge decreases in proportion to **B/H**, and that if **B** is equal to **H**, the discharge will be half that for the 90 degree notch under the same head, yet it is essential that such weirs be specially calibrated, and this is always done by the companies supplying them. This weir has many applications.

Selection of The Measuring Method

Generally one has an approximate idea of the flow to be measured. If it is small, the orifice or the V notch with small angle is most convenient, but if it is in the neighborhood of 700 gallons per minute, then a 90 degree V notch is available with a head a little under 0.83 ft. (10 in.) or a rectangular weir could be used. In the latter case it would not be desirable to use a weir one foot long with a head of nearly 6 in. because, in general, the head should not be over one quarter of the length; it would be better to use a two-foot length with a head around 4.6 in. or a three-foot length with about 3.5 in. head. Good judgment is essential. The use of the stilling box is recommended for accuracy in getting **H**.

Correction!

Practical Hydraulics Series—X

Prof. Robert W. Angus, Consulting Engr. of Toronto, Canada, and author of the currently running series of articles on "Hydraulics for the Practical Water Works Man", has written to call our attention to some errors which appeared in the tenth article which was published in the July issue of *Water and Sewage Works*. The corrections follow:

Page 246, col 3, line 35 reads "0.6 x 12 or 7 in."; it should read "0.7 x 12 or 8 in." to agree with Fig. 35.

Page 246, col 3, line 45; the differential is 15 in. mercury.

Page 248, col 1, line 23, the formula should read

$$\text{Coefficient of discharge } \sqrt{\frac{V_2}{63.4\ H}}$$

Page 248, col 1, last line is poorly printed; it should read

$$0.984\ \sqrt{63.4\ H}$$

"WE WORK WHILE YOU SLEEP!"

The Story of One Waterworks Chemist as Told to Mr. and Mrs. John Q. Public

By JOSEPH P. MILLIKIN
Chemist and Bacteriologist
ROANOKE WATER DEPT.
ROANOKE, VA.

WE ARE all familiar with the Biblical story of how Moses smote the rock with his staff and water gushed forth. In those ancient times this was a miracle of the first magnitude, but an even greater miracle is the fact that by a simple turn of the wrist we can obtain an abundant supply of cool, clear, pure water. This water does not usually come from a rock or spring near our door step, but may be from sources 75, 100, or even more, miles away.

Day or night, winter or summer, the supply is unfailing. Next in importance only to the air we breathe, it is the most vital essential of human life; the universal food, as someone has called it. As a commodity it is so common and so easily obtained that we take it all for granted, little realizing the amount of work and extreme care taken by the chemist and the engineer in furnishing it to us.

There are many citizens who do not know how their water is protected and purified. Even while you are sleeping at night, there are plant operators and chemists at work protecting your health—yes, "We work while you sleep!"

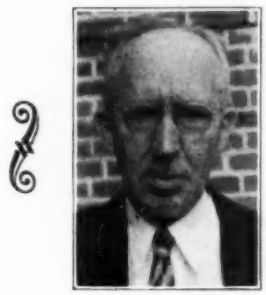
Water Scarcity and Abundance

Those who have traveled in foreign countries know that in many places water can only be obtained by paying for it at so much a bottle. In certain parts of Italy, Greece and France, pure water actually costs more than wine. In Egypt and other countries of the desert, water is so precious that it is a common occurrence to see it sold from bags made of goat skin. In the crude mud huts of the Egyptian peasants the only furniture is a water bag or bottle and a sleeping mat. Water is carried by hand and is too precious to be used for bathing.

In our own country water is so cheap that no one is deprived of it; and, why should they be, for it is within the reach of everyone.

Water-Borne Disease

Many diseases of the human race are so devastating and so easily communicated that laws have been passed and regulations put into effect seeking to protect the healthy by prevention of unnecessary spread of disease. Water is a universal commodity and a natural carrier of disease and must be closely guarded.



The Author

This paper was prepared by Mr. Millikin as the basis for talks before civic groups, service clubs and the like in his home town.

We take pleasure in printing "We Work While You Sleep!" as another example of the sort of thing that every water works man should have available for use whenever he finds the opportunity to talk "Hometown Water Service" to the public.

We realize that many of our readers have done what Mr. Millikin has, and perhaps even better, but we like the provocative title of his talk—"We Work While You Sleep!"—as a luncheon meeting topic, or headline for an item in the Sunday paper.

Let this represent a challenge, or let's say an invitation, to other water works men to submit what they may have developed as a discussion of "Hometown Water Service" for the hometown folks who can only answer the question "Where does your water come from?" by the answer "From the spigot."

We will print the more outstanding of these discussions. And for the best two, in the opinion of competent judges, we will make appropriate awards to the authors. However, we do not put these awards out as being half as important to those who submit their discussions on the "Hometown Water Service" as the thought of passing along to others some basic ideas for use in developing similar talks of their own.
—The Editors.

This is the work of the chemist, whose job in life is eternal vigilance.

There are rigidly enforced laws controlling the distribution of milk. Usually there are a number of distributors and the supply of milk comes from more than one dairy. If an epidemic should occur from milk, the ones suffering are comparatively few. With water it is a different proposition; water falls in the class of big business. Thousands of dollars are expended for mains, pumps, services, sources of supply and treatment plants. The health of not only a few people but of the whole community depends on an adequate supply of pure water and if the present supply is not sufficient it may take years to develop a new source of supply. In this way it differs from all other utilities.

Water Purification

To gain the objective of furnishing a pure supply to its citizens, cities must purify the water by treatment including filtration, sterilization and further protect it from contamination by unpurified or polluted supplies of industrial establishments connected to the pure water mains of the public supply.

Purification is an absolute essential to prevent epidemics of typhoid fever, diarrhea, dysentery, cholera or any other water-borne disease. It can be said of the last mentioned disease, cholera, that there has not been an epidemic of this disease for many years due to our sanitary laws and the continued vigilance and care that the chemist has exercised in producing pure water.

The idea of purification had its beginning many years ago. History informs us that the first thought of purification was that of straining through a cloth or boiling it. In 1612 the importance of keeping filth and pollution from the sources of the community water supply was known and laws governing this phase were passed in England at that time.

As the towns and cities grew the water supply became more and more important and we learn from history that the first sand filter was built in London, England, in 1829. This is

what we now term a slow-sand filter of which, at the present time, there are quite a number (with modern improvements) in use in this country. This type of filter is dependent upon slow acting biological purification. It is very efficient and produces a clear and sparkling water. The rapid-sand mechanical filters came into use sometime later and with them it was necessary to use a chemical coagulating agent to aid filtration. Alum is generally used, but there are several other chemicals that may be used. The alum does not remain in the water but precipitates out along with the enmeshed impurities.

The first requisite in drinking water is that it must be, not only clear and sparkling, but also free from any of those bacteria which are harmful and will cause disease. To obtain this end the water must be disinfected. Disinfection may be accomplished by treating the water with chlorine in minute doses.

England's Early Chlorination Put on Practical Basis by America

The first recorded use of chlorine was as a compound containing this element used in treating water as an emergency measure in Maidstone, England, in 1897, during an epidemic of typhoid fever. It had, however, been tried as an experiment in Germany a few years prior to this date.

It was first used as a regular treatment of a water supply at the Boonton reservoir of the Jersey City water works in the latter part of 1908 when the daily consumption was some 40 million gallons. This treatment was later changed to liquid chlorine and the use of this chemical spread quite rapidly until at the present time it is almost universally used.

Disinfection, sometimes referred to as sterilization, is by far the most important and essential item in water purification.

This process of chlorination is closely watched and guarded by the chemist. Tests are made daily from the various sources of supply. These samples are treated to promote the growth of water-borne bacteria, should any be present. No food manufacturing process is more scrupulously watched than is the production of water.

Taste and Odor Control

The duties of the water works operator and chemist are many and varied. To produce water that is clear, sparkling, pure and free from harmful bacteria is but part of the job that must be attended to. In addition to these the water must or should be free from odor and taste. To achieve this end the reservoir from which the supply is taken must be treated periodically with a chemical to kill any algae or plant growth. Algae are microscopic plants which float in the water, and give off unpleasant odors or decided tastes. This periodic treatment of the reservoir was the only treatment, except possibly aeration, to remove both odor and taste, until in 1930 when activated carbon (a highly purified charcoal) was used in Hackensack, N. J., to remove odors and taste by adsorption. The carbon is removed in the filtration process.

Since that time this chemical has been widely adopted. If used in the correct proportion it will remove almost any odor or taste.

Iron and Manganese—Corrosion

The city water supply may contain troublesome iron and manganese which must be removed to render the water satisfactory. This is done by oxidation, either by aeration or by adding some oxidizing agent. The oxidized iron or manganese is removed by filtering.

Still another item in purification is the treatment of water to prevent corrosion. Some water, particularly soft water, has a tendency to corrode (rust) pipe lines. If not corrected this corrosion may cause rusty water which the water operator refers to as "red water." If allowed to continue long enough, corrosion eats holes in the customers' pipes. Treatment for corrosion usually involves the addition of small amounts of lime or other anti-corrosion chemicals to the water.

Elisha Believed First Water Purifier

I have mentioned but a few of the many chemicals which are used in modern water treatment. Chemical treatment of water, however, is not new but very ancient, for in 2nd Kings Chapter 2 of the Bible we read:

> "And the men of the city said unto Elisha, Behold, I pray thee, the situation of the city is pleasant, as my Lord see-eth, but the water is naught, and the ground is barren.
>
> "And he said, bring me a new cruse, and put salt therein, and they brought it to him, and he went forth unto the spring of the waters, and cast the salt in there, and said Thus saith the Lord, I have healed these waters; there shall not be from thence any more death or barren land. So the waters were healed unto this day according to the saying of Elisha which he spake."

Cross Connections

In addition to all these, the chemist must be on the lookout for contamination of the city's water supply from private supplies which may be polluted. A manufacturing plant may have its own water supply for fire protection or industrial use cross connected with the city supply. The chemist must examine the industrial supply for possible contamination. If found to be contaminated the public water utility must insist on such mechanical appliances as will insure against the municipal supply line being polluted by this private supply being forced back into the pure water mains, no matter what conditions may exist.

Accident or health insurance to protect one's self and family are considered essential to most persons. The city authorities in like measure may be said to take out similar insurance, only in this case they do so by employing an honest and efficient personnel to protect the water supply.

It will be noticed from the foregoing that water is not just something drawn from a spigot which many seem to think is God-given. To the contrary, water preparation for human consumption must, of necessity, be conducted with the utmost care and precision.

In this short paper I have tried to show the importance of the water works operator and chemist, his responsibilities and duties. It was Dr. Thomas Parran, Surgeon General, U. S. Public Health Service, who said, "Perhaps no individual holds a greater responsibility in so far as the health of the community is concerned than the operator of a public water supply plant and this responsibility increases as the sanitary qualities of the water decreases."

Let us give thanks for the high standards of the water service; for the operators and chemists who are more concerned with the community's health than with money or even their own comforts; for the chemical and technical knowledge that is now available and for an enterprise that knows no such thing as a holiday or let down in service. Yes—**"We work while you sleep!"**

A COPPER SULPHATE DISTRIBUTING CRAFT*

By SIDNEY S. ANTHONY
Supt. & Engr.
AUGUSTA WATER DISTRICT
AUGUSTA, ME.

AT more or less frequent intervals during the past five years the supply for the Augusta Water District, Carleton Pond, has become infested with numerous types of algal growths which have been very bothersome. Various methods of reservoir treatment for algae control have been tried, but with unsatisfactory results.

We have used the time honored process of dragging sacks of copper sulphate (Bluestone) crystals behind a small motor boat at various times.

The method of dragging bags seemed to me to be rather inefficient, since narrow streaks of water were heavily dosed, and there was no way to be sure that the entire surface was being treated.

About that time I ran across a booklet which contained an article by Frank E. Hale, Ph. D., entitled "The Use of Copper Sulphate in Control of Microscopic Organisms." On page 23 of this booklet appeared a snap-shot of a barge being towed behind a motor boat and spraying chemicals over a wide area, perhaps twenty-five feet wide. This set me to thinking and I experimented a little bit.

A Work-Boat Equipped for Trial

We had a work-boat, square ended and about 15 feet long and four feet wide, on which could be mounted a 9 hp. outboard motor and which would travel nearly ten miles per hour. I had a distributor pipe made up about 12 feet long, consisting of short pieces of 2 in. pipe and 2 in. x ½ in. tees with ½ in. nipples in the side outlets. A hose connected this distributor to a 3 in. gasoline ditch pump, with a length of suction hose thrown over the side. A smaller hose ran from the suction tee to the bottom of a half section of a galvanized range boiler. A small hose also led from the discharge of the pump to the other end of the range boiler. The procedure was to start the outboard motor and the ditch pump, which delivered part of its water to the boiler and part to the distributor. A man standing beside the boiler scooped copper sulfate crystals into the boiler and stirred the mixture which then passed through the pump and to the distributor pipe. The scheme worked pretty well except for two things: the boat was so small and low in the water that the slightest chop scared the operators to death; and also the crystals dissolved too slowly. We tried again, this time with pulverized copper sulphate. The solution rate was satisfactory, but even a slight breeze filled the air with dust and irritated the eyes, nose, and throats of the operators.

The Author

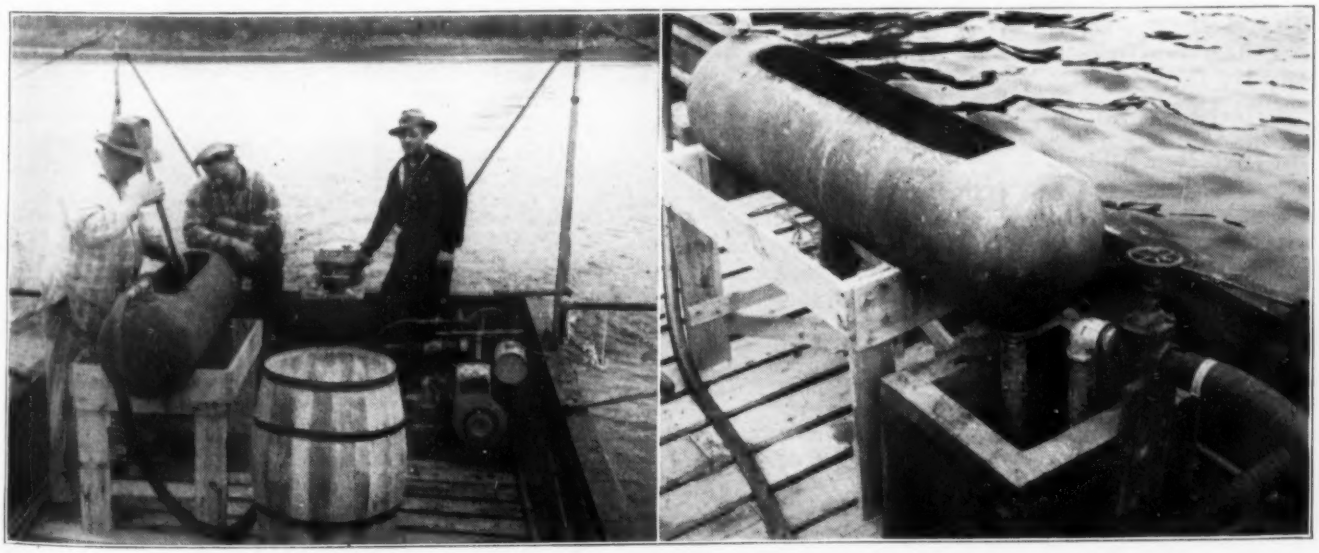
Distribution by Air Blowing Tried

Then we tried a small blower made up with a gasoline engine drive to spread the powder, but the powder caked in the hopper of the blower and would blow back, or rush out in chunks, or not at all. The blower was intended to cover a much larger area of pond surface, but wind conditions had to be about perfect, which they seldom are when you want them to be, so we gave up the idea of broadcasting from the blower and went back to the spray method.

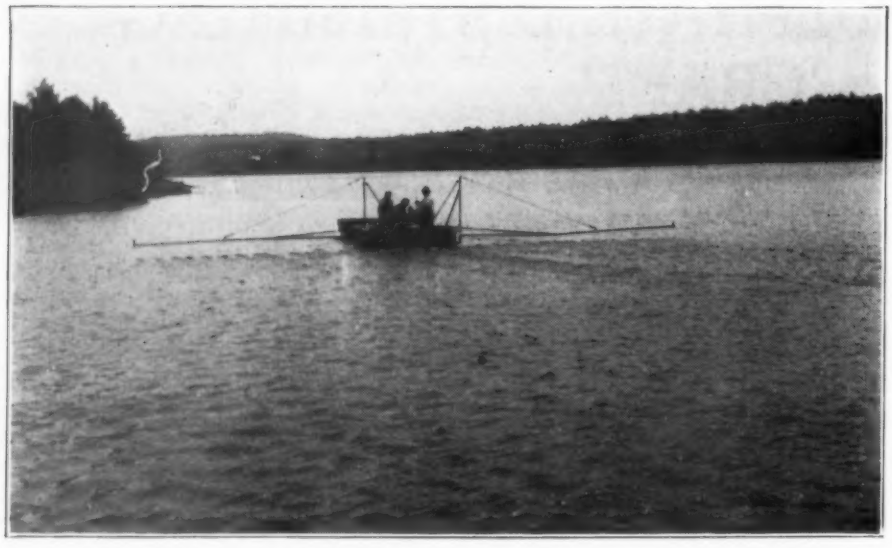
We Design a Craft

We knew that a craft large enough to be safe, and large enough to carry a good supply of copper sulfate and the equipment necessary was essential, so such a craft was designed. Since this was early 1945, and most small boat yards in Maine needed

(*This paper, presented before the NEWWA and NHWWA, is being printed by permission of these Associations.)



Arrangement and Operation of Floating Equipment for Dissolving and Feeding Copper Sulphate.
(On right, a close up of dissolving tank and mixing box.)



The Coppering Craft—"Bluestone"—Showing 50 foot Distributor Spread.

work, we had no difficulty in locating a yard willing to do the job. I knew what was wanted, but being no yacht designer the sketch I took down drew a few laughs and suggestions of changes. The changes were made and the craft, which we christened "The Bluestone", was built, as you see in the accompanying pictures. It is 24 feet long, 8 feet wide and 2 feet deep, with an undercut bow which I hoped would cause it to move more easily through the water. It is built of fir planking, oak ribs and hard pine rails and weighs about two tons without equipment. It will support about 4 tons of load with an 18 inch draft. Its cost was $475.

Piping Arrangements and Pump

The piping arrangement seen in the pictures was first placed across the bow, but the extra weight made it ride low at the bow and high behind, so it was shifted to the position across the stern. The original piping was galvanized iron which lasted about one season. When used early this year corrosion had damaged the threads to the point where the piping fell apart, so the entire piping has been replaced with red brass pipe and fittings.

Each hose line is valved so that the flow of water can be diverted to flush various parts of the system, stop flow to some parts, or to pump out the scow when it is filled with rain water.

The pump used is a standard make 3 in. self priming ditch pump reduced to 2 in. inlet and outlet; suction and discharge hose is 2 in. wire-wound suction type hose. The water supply to the mixing tank is 1¼ in. high pressure hose. A short piece of this same hose is used as a suction line for pumping out the bilges when required.

Performance

A crew of three men can apply more than 4,000 pounds of pulverized copper sulphate per eight hour day, one man operating the outboard motor, one scooping powder into the tank and the other stirring the mixture. They take turn-about at these jobs so that there is no monotony.

The helmsman keeps track of the course and sights on a tree or bush on the opposite shore about 100 feet from the last cross trip in that direction, and then turns for the other shore. After crossing back and forth the course is changed to longitudinal trips. First, however, when starting treatment, two or three trips are made around the shores to reach the shallows and provide turning areas without missing any part. The solution applied contains about 1% copper sulphate.

The pond is divided into three parts according to volume of water in each part. We have depth soundings which indicate a total volume of water of about 1,800,000,000 gallons of which 725,000,000 gallons are available above the intake. Treatment is based only on the available water, on the theory that the sinking copper sulfate solution does its work as it sinks.

Buoys are placed at these three division points and sufficient copper sulfate is loaded in the scow to treat one of the thirds, after which a return is made to the storehouse for another load.

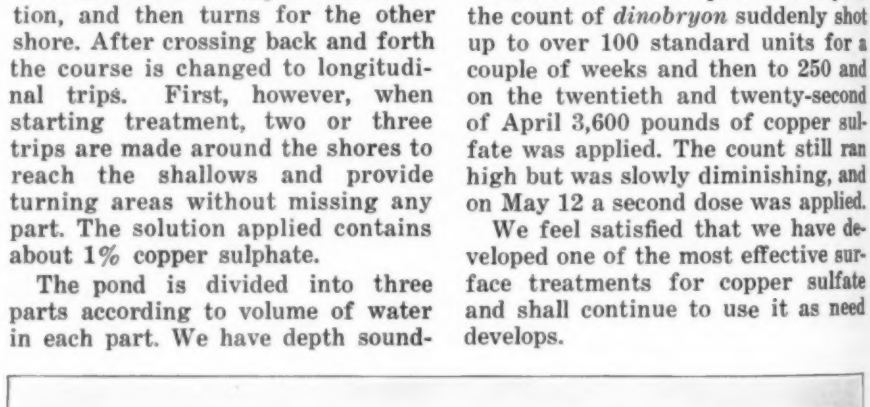
Effectiveness

The effectiveness of this method of copper application was impressively demonstrated in the late Summer of 1945. A rapid increase in the number of standard units of organisms during late July and early August indicated treatment would be required and it was on V-J day that treatment was started. It was completed the next day.

From September of 1945 until April of this year (1947) weekly examinations of the water taken from the gate well showed not more than ten of any variety of organism present, and many of the reports showed a long string of zeros, with notations that "occasional" this or that were present.

In the middle of April of this year the count of *dinobryon* suddenly shot up to over 100 standard units for a couple of weeks and then to 250 and on the twentieth and twenty-second of April 3,600 pounds of copper sulfate was applied. The count still ran high but was slowly diminishing, and on May 12 a second dose was applied.

We feel satisfied that we have developed one of the most effective surface treatments for copper sulfate and shall continue to use it as need develops.



A Closer View of the Craft with Crew in Operating Positions

OPERATION OF SMALL FILTRATION PLANTS

II. Pumps and Motors

The Second of a Series of Articles

By A. E. CLARK
General Manager
NASHVILLE SUBURBAN UTILITY DISTRICT
NASHVILLE, TENN.

The Author

A PREVIOUS article in the August, 1947, issue of *Water & Sewage Works* dealt with small plant operation, particularly in regard to laboratory control tests as applied to the operation of the plant. These articles will deal with actual operation of the plant and examples of application of control tests to the production of a safe and satisfactory water. It will be assumed that the plant is relatively small, operating only during the day. Small plants are usually operated by one or two men; if by two men, an operator and helper, with the helper sufficiently trained to operate in case of sickness or any other cause which would make it impossible for the operator to be on duty. If operated by one man then provision should be made to have another employee trained to step in in any emergency. Operating and maintenance costs can be kept at a minimum if operating and maintenance instructions are followed.

Low Lift Pumps

Practically all pumping is done with centrifugal pumps, driven generally by electric motors. In the case of low lift pumps, unless the top of the pump casing is below the level of water to be pumped it may be necessary to prime the pump before it will operate. If the foot valve is tight it may hold the pump full of water, otherwise it will be necessary to fill the suction line and pump casing with water. This may be done using a vacuum to pull the water up into the pump casing or, if either a gravity flow or pressure supply is available it can be piped to the pump and by simply opening a valve the casing can be filled.

All oil reservoirs on both the pumps and motors should be checked before starting and after starting. If oil rings are used, check to see that they are operating freely. Keep the oil level up to the mark. See that all valves are in the proper operating position. If valves, particularly on the pump suction and discharge lines, do not have indicators it is a good idea to have some metal or wood tags made, lettered "Open" and "Shut," which can be hung on the hand wheel. In the case of hydraulically operated valves the position of the stem indicates whether the valve is open or closed.

After the pump or pumps have been in operation a short time, check all bearings to be sure there is no excessive heating. Check packing glands for excessive water leakage. Keep all packing glands properly packed with the recommended type, size and number of rings of packing. Follow the manufacturer's instructions. When repacking do not take up the gland too much, because excessive heating can result with consequent damage to the shaft. It is well to allow a little excessive leakage until the packing is worn in, then take up on the gland a little at a time until it is properly adjusted. Use care in taking up the gland to see that it is not cocked. Take up the same amount on each nut when tightening.

Some low lift pumps are equipped with automatic starting and stopping devices. This is to prevent overflow of either the tank or basins. The automatic equipment can be set to maintain the water level between high and low marks. The setting depends on local conditions and construction features of the plant. If the plant operates at a uniform rate, which is the same as the pumping rate, manual operation is then satisfactory; but when the rate is not uniform, automatic start and stop is most desirable.

Check the suction and discharge gages. This will show if the pump is operating normally. If there is a variation from the normal, check the pump and motor to locate the trouble. It is assumed that the gages are correct and if there is any question regarding their accuracy they should be checked and adjusted if necessary. Where it is possible for foreign material, such as fish, eels, leaves or other debris, to get into the pump, a low reading on the discharge gage may indicate partial stoppage of the impeller and in this case there is one remedy. Remove the top of the casing and clear out the debris causing the trouble.

Keep the pump or pumps in good operating condition at all times. At the first sign of trouble have the proper repairs or adjustments made. If the low lift pumps do not operate no other part of the plant operates and the reserve supply in the storage tank or reservoir begins to disappear. The amount of water stored may be sufficient with normal use to last 24, 36 or 48 hours, but think what could happen in case a relatively large fire broke out. It is surprising how fast a supply can be depleted. What if one of the mains broke and was not shut off for sometime. A six inch main under, for example, 60 psi. can get rid of a lot of water in a short time. These are things which the operator must keep in mind at all times. The unusual can happen at just the wrong time.

High Lift Pumps

High lift pumps connect into the clear well and pump this water to the distribution system and into the storage tank or reservoir. Except in the case of a main break or some other condition which might drain the discharge line, these pumps stay primed. All the other conditions of starting low lift pumps should be observed in starting high lift pumps. High lift pumps are operated at much higher pressures than the low lift pumps.

Check the suction and discharge gages regularly. There is no danger of getting debris in the high lift pumps except through carelessness. A drop in discharge pressure is due to some other cause and should be investigated and corrected immediately. Trouble due to impeller wear, change in clearances, etc., will call for a pump man or manufacturer's representative to remedy the difficulty.

Some provision should be made to stop the high lift pump or pumps when the storage tank or reservoir reaches the high water level. This can be done by installing a specially designed valve such as manufactured by Golden-Anderson, Ross, etc., This type of valve will close automatically when the desired level has been reached and this in turn will build up sufficient back pressure in the main to trip the electrically operated stopping device at the plant thus shutting off the high lift pump. By the use of more elaborate equipment the pumps can be started and stopped maintaining a relatively uniform level in the storage tank or reservoir.

Wash Water and Auxiliary Water Supply

Water for washing filters may be obtained from the high pressure line by means of an automatic valve which maintains a uniform level in the wash water storage tank. If the plant is so situated that the distribution system is supplied by gravity, then it is necessary to provide pumping facilities either for filling a wash water storage tank or to install pumps of large enough capacity to supply the proper amount of wash water direct to the filters from the clear well storage. In either of the two latter instances maintenance of the pumps is required. Although the operating time per day is relatively short, the usual precautions should be observed when the pumps are operating.

Some plants have installed auxiliary water supplies when conditions demanded, to supply water for the chemical feed machines, chlorinators, wash room and laboratory and for any other uses around the plant. These auxiliary supplies usually consist of a pressure tank, pump for filling from the clear well and an air compressor to maintain a definite pressure of air in the tank to provide the required pressure throughout the plant. The pump, air compressor and motors should receive the same maintenance as outlined above. The level of oil in the reservoir of the compressor should be checked regularly and kept up to the mark. The oil should be changed at intervals as specified by the manufacturer and using the weight recommended.

Motors

Unless electrical maintenance is always done by some one other than the operator, different types and sizes of new fuses should be kept in stock at the plant in case one or more is blown. For trouble other than a blown fuse a competent electrician should be called in to adjust or repair electric motors. Electric motors collect considerable dust and they should be blown out at regular intervals with compressed air. It is extremely hazardous for an operator to attempt to work around the electrical equipment unless he has been trained in this work. Motors operating on the higher voltages, that is, above 220 V are quite common and it is an easy matter for one not trained to obtain a shock which might prove fatal.

Safety

The principles of safety should be learned and observed at all times and this cannot be stressed too much. Operators are apt to become less cautious around the mechanical equipment as they become more familiar with it. This is a very serious mistake because that is the time when an accident can happen, many times fatally.

Instructions

Operating instructions for practically all equipment are furnished by the manufacturers. These instructions should be studied and the operator should be thoroughly familiar with all the equipment. It is important to follow the manufacturers' instructions, because the equipment was developed to work under certain conditions and for a definite purpose and in most instances the desired results are obtained if the instructions are properly followed.

Errata to 9th Ed. of Standard Methods

The APHA and AWWA have noted the following corrections to be called to the attention of anyone using the Ninth Edition of the Standard Methods for the Examination of Water and Sewage:

1. Page 24, Sec. 10, B, 1.6 The formula for determining the reagent value of potassium palmitate should read: Mg. $CaCO_3$ per ml. potassium palmitate equals ml. standard calcium chloride soln. divided by ml. potassium palmitate soln.
2. Page 54, Sec. 24, D, 3, line 6 should read: To about 40 ml., add 5 ml. of 3 N HCl. . . .
3. Page 216, Appendix I, left column, Sec. 4, 3, line 31, sentence should read: Copper does not interfere below 0.2 ppm. (Delete the words "the maximum limit permissible according to the 'Drinking Water Standards' of the U. S. Treasury Dept.")

The above corrections concern the only errors appearing in the Ninth Edition that have been called to the attention of the editorial staff.

If any of our readers have found other errors please advise the APHA, or the AWWA or write to us.—Incidentally the first printing is completely sold out. The second printing, however, will be available in June.

Norgaard Joins Ken Brown in San Francisco

John T. Norgaard, Senior Civil Engineer, U. S. Public Health Service, in San Francisco, has resigned his position to join the consulting firm of K. W. Brown of San Francisco.

During the war, Norgaard was located in Washington attached to the Chief of Engineers' staff, where he was associated with Louis Kessler.

Prof. Lendall Appointed to N. J. Public Health Council

Prof. Harry N. Lendall, Chairman of the Dept. of Civil Engineering and Professor of Municipal and Sanitary Engineering at Rutgers University, was appointed to the seven-year term of the first Public Health Council of the State of New Jersey. Prof. Lendall had formerly been a member of the State Board of Health, having served from Sept. 1946 until July 1, 1947, when the board was terminated.

The new Public Health Council marks the first step under the law reorganizing the State Dept. of Health, passed by the present legislature.

Prof. Lendall is also a member of the Interstate Sanitation Commissions of N. Y., N. J., and Conn., and is well known throughout New Jersey and the east for his teaching and his work in the field of sanitary engineering.

THE SEWER SCOOTER

A Simple but Highly Efficient Sewer Cleaning Device

by M. W. LOVING
Consulting Engineer
CHICAGO, ILL.

CLEANING sanitary lateral and intercepting sewers in Miami Beach, Florida, has become a very easy task for the maintenance crews, because Andrew E. Kelpsh, Superintendent of Sewers for Miami Beach, invented a simple but effective device to do the job.

M. N. Lipp, City Engineer of Miami Beach, told me on March 26, 1947, that his city has the cleanest sewers in its history because of the efficient operation of the Kelpsh "Sewer Scooter," a device now manufactured by J. C. Fitzgerald of Coral Gables, Florida.

For the writer's benefit Mr. Kelpsh and a maintenance crew demonstrated the operation of the "Scooter" in cleaning an 8 in. lateral sewer and a 12 in. inverted syphon. The operation was as follows: A scooter was lowered into a manhole at Collins Court in 10th Street and in exactly 12 minutes it cleaned this lateral to Euclid Avenue, a distance of 945 ft. Although it was stated that this was a comparatively clean sewer, you should have seen the rubbish that was removed from the manhole at Euclid Avenue—sand, sludge, coagulated grease, rocks and about everything usually found in sewers. The sewer was flowing about half-full and the velocity was about 2 ft. per second.

A 12 in. inverted syphon of cast-iron pipe from Indian Creek Drive, under Indian Creek, to Flamingo Drive was cleaned with the same scooter, fitted with a 12 in. shield. The time required was only 3.5 minutes. This syphon is 225 ft. long and is fitted with four 22 degree bends and one 11 degree bend. Even razor blades were removed from this syphon.

Miami Beach Sewers Built on Very Flat Grade

The lateral and intercepting sewers of Miami Beach are built on flat grades through sand, mangrove swamps, muck and the like. For the most part the invert gradient of Miami Beach sewers lies below the water table. Infiltration is a major problem—because the ground water transports sand in suspension through defective joints into the sewers. Because of the flat topography and high ground-water table, most sewers had to be constructed on a very flat grade. In some places old sewers have settled because they were not constructed on stable foundations. Thus sumps filled with suspended matter must be cleaned at frequent intervals and Mr. Kelpsh said the scooter will clean these old sewers in nothing flat, thus reducing the cost of maintenance to a remarkable extent. When and if a sewer is crushed the scooter can be drawn back to the next manhole and removed—thus it is very useful in locating major defects which are usually discovered only when the surfaces of streets sink into caverns formed in the soil mass around and over such places.

Fig. 1. Inventor Kelpsh and His "Sewer Scooter"

In many Florida cities, the sewers are constructed through sand and the water table is above invert gradient. In many cases, too, the sewers are constructed on flat grades, hardly sufficient to provide self-cleansing velocities flowing full or half full. And the dry weather flow in many cases is insufficient to provide velocities of more than one foot per second; thus the pipe lines often function as "elongated cess pools." Joints of the pipe lines are often poorly made, and in one city the joints of some of the pipe sewers were actually made with *Spanish moss.* The city engineer of one Florida city told me in July 1945 that real estate promoters built sewers in and around his city in 1925-26 with no outlets and did not consult him about grades, nor did they concern themselves as to whether the "sewers" they were throwing in their sub-divisions would even function. When these sub-divisions had to be taken over by the city the sewers had to be abandoned and new ones constructed, or else the property owners had to build septic tanks—over the "sewers." In one near-by city, he said, all the sewers had to be abandoned because they were filled with sand.

A Maintenance Headache

The men charged with maintenance of such sewers have a first

Fig. 2. The Scooter in Position for Passing Through the Sewer

Fig. 3. The Scooter in Collapsed Position Created by Pull on Tow-Rope

Fig. 4. Changing Shields on the Scooter

class headache day in and day out; and any simple sewer cleaning device as the sewer scooter is a God-send. It is the rule, rather than the exception, that lateral sewers are cleaned at regular intervals in many Florida cities, and the same should apply in cities, large and small, in all sections of the United States.

In January 1947, a prominent consulting engineer asked me to review plans and specifications for new relief sewers in a city that are to be built at a cost of $9,000,000. The existing sewers were constructed through sand and the water table is above invert gradient; joints of the pipe lines were defective and some of the 48 in. sewers have a deposit of 3 ft. of sand and sludge in them and the 60 in. lines are filled to 4 ft. At his request the city officials authorized the City Engineer to clean the sewers for the first time since they were constructed during the period 1917 to 1922. This is costing $125 a day for each crew, and the sewage is being discharged, untreated, into the river by special permission of the State Board of Health.

Fig. 7. Fishing up the Tow-Rope

If these sewers had been cleaned once a year with such a device as the sewer scooter, all or most of the flooding of hotel and office building basements in that modern city could have been avoided. Although this is one of the worst cases of record there are too many similar to it.

Adequate Maintenance a First Essential

Adequate maintenance is a first essential in all sewer systems, including those properly designed and constructed. I would like to make it clear at this point that I have no interest in Mr. Kelpsh's sewer scooter, financial or otherwise, but I am very interested in the proper design, construction and maintenance of pipe lines.

The pictures shown were taken by the writer while in Miami Beach,

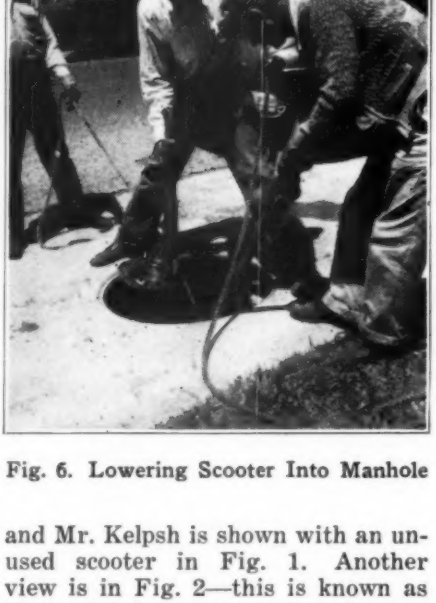


Fig. 6. Lowering Scooter Into Manhole

and Mr. Kelpsh is shown with an unused scooter in Fig. 1. Another view is in Fig. 2—this is known as the model A-3; it is made of bronze and consists of a carriage frame and three interchangeable shields for cleaning 8, 10 and 12 in. sewers. A shield for cleaning 15 in. sewers is supplied separately. When the going gets tough, and a lot of stuff is ahead of the scooter, a tug on the tow-rope will collapse the upper half of the shield as shown in Fig. 3. Thus the volume of sewage traveling at a high velocity will flush and remove all sand, sludge, rocks, etc., ahead of the scooter. This scouring effect is realized because the energy of water in motion varies as the cube of the velocity and it is amazing how much energy can be created by this simple device. They told me that mortar, protruding at joints, can be sheared off by fitting the scooter with an all-metal shield which does not

Fig. 5. Replacement of Shield, a Simple Operation

have the rubber facing. When and if the scooter gets stuck in a broken pipe, by collapsing the upper half, it can be drawn back to the first manhole with the tow-rope.

In Figs. 4 and 5 Mr. Kelpsh is removing the 8 in. shield—a simple operation in the field. The tow-rope trails the scooter and after it passes a manhole the workmen fish up the rope with a metal rod, fitted with a hook, as shown in Fig. 7. (Note the clean condition of the man's shoes—all because sewers are scientifically cleaned in Miami Beach.) Then the tow-rope is neatly folded ready to be placed in the truck, as shown in Fig. 8.

The cleaning of the 12 in. cast iron pipe inverted syphon, under Indian Creek, is shown as far as possible in Fig. 6.

The "Sewer Scooter" is also made to clean sewers from 15 to 36 in. and this one is known as model B. I understand that a model C scooter can be had on special order to clean sewers even larger than 36 in.

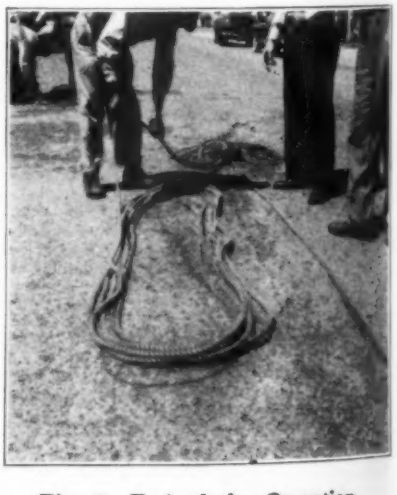


Fig. 8. End of the Operation

SAND FILTRATION OF SOME ORGANIC WASTES*

By WILLEM RUDOLFS and VICTOR DEL GUERCIO
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TREATMENT of strong organic industrial wastes produced in relatively small quantities may be accomplished by digestion, aeration, or filtration on coarse-grained filters, but the effluents produced may be unstable or may contain considerable amounts of B.O.D. It is, in fact, extremely difficult to treat such wastes alone by the activated sludge process. In an effort to determine how far the treatment could go and what the allowable loadings could be, a series of laboratory experiments were conducted over a period of about a year, utilizing intermittent sand filtration. The industrial wastes selected were latex (chewing gum), slaughterhouse, penicillin (spent broth), sulfite liquor, yeast (spent broth), and sugar (candied fruit). Some of the wastes were pretreated by anaerobic digestion in order to determine whether the digester effluents would behave in a similar manner as the raw wastes when applied to sand filters.

The Senior Author

wastes were diluted to about 1000 ppm. B.O.D. prior to filtration.

The suspended solids and B.O.D. of the settled wastes averaged:

	Susp. Solids ppm.	B.O.D. ppm.
Latex (digested)	122	1,700
Slaughterhouse	104	1,355
Penicillin	54	4,350
Sulfite	0	20,000
Yeast	60	3,150
Candied fruit	107	6,500

The sulfite and candied fruit wastes did not contain enough nitrogen to sustain a proper bacterial flora in the filters, therefore ammonia was added as NH_3Cl on the basis of about 1 ppm. NH_3-N per 15 ppm. B.O.D.

TABLE I
AVERAGE RESULTS OBTAINED WITH SAND FILTRATION OF LATEX DIGESTER EFFLUENT

Dosage gpad.	Applied Effluent B.O.D. ppm.	B.O.D. lb./acre	NH_3-N ppm.	B.O.D. ppm.	NH_3-N ppm.	NO_2-N ppm.	NO_3-N ppm.
20,000	1880	313	58.3	36	7.5	0.9	86.1
40,000	1720	568	7.0	32	2.0	0.2	54.5
60,000	1720	852	7.2	47	2.0	0.2	40.0
80,000	1460	982	7.0	57	2.0	0.2	37.0

Methods and Materials

The laboratory sand filters consisted of glass columns containing 24 inches of filter sand over 1 inch coarse glass beads. The mature sand was obtained from a sewage treatment plant and had an effective size of 0.35 and a uniformity coefficient of 2.37. The filters were operated 8 hours a day. All wastes were presettled. In order to avoid a complicating factor in the comparison of results, the wastes were settled prior to filtration and neutralized when required to a pH of 7.0. To further facilitate comparisons, the strong

Results

1. *Latex*

The average results obtained on filtration of latex (chewing gum) waste, previously digested anaerobically, with effluent applied in dosages varying from 20,000 to 80,000 gal. a day and B.O.D. applications of 313 to 982 lb. per acre a day, are shown in Table I. B.O.D. values from 1,500 to 1,800 ppm. were reduced to 30 to 60 ppm. in the effluent or by 96 to 98 per cent. The effluent was well stabilized, containing from 37 ppm. NO_3-N at the highest loading to 86 ppm. NO_3-N at the lowest loading.

2. *Slaughterhouse*

Settled slaughterhouse waste was applied at rates beginning with 20,000 gal. per acre a day and gradually increased to 200,000 gpad. or equivalent B.O.D. loadings of 167 to 1,735 lb. per acre. The concentration of the applied waste was kept approximately constant at 1,000 ppm. Up to loadings of 1,400 lb. per acre the B.O.D. in the effluent remained below 5 ppm. The average results obtained for the various applications are given in Table II. Nitrification was high at all loadings, varying from 40 ppm. NO_3-N at the higher loading to 103 ppm. at the lowest loading. The pH values of the effluent at lower loadings were much lower (3.5 to 4.0) than at the higher loadings (5.8 to 6.4). It has been shown in early experiments (Amn. Rept., Mass. State Bd. of Health, 1891, p. 448) that acid in sand filtration of sewage tends to prevent nitrification and checks but does not prevent the oxidation of organic matter. It has been assumed that acidity resulting from stabilization of waste would be detrimental to the nitrification of the waste. The results obtained with this type of waste indicate that neither the nitrification nor the oxidation is much, if any, affected by the acidic compounds formed.

TABLE II
AVERAGE RESULTS OBTAINED WITH SAND FILTRATION OF SETTLED SLAUGHTERHOUSE WASTE

Dosage gpad.	Applied Effluent B.O.D. lb./acre	pH	NH_3-N ppm.	Total N ppm.	pH	NH_3-N ppm.	NO_2 ppm.	NO_3 ppm.	B.O.D. ppm.
20,000	167	7.0	9.5	196	4.0	43.3	0.1	103	2
40,000	334	7.0	9.5	196	3.5	31.0	0.6	71.5	2
60,000	500	7.0	6.0	141.5	3.6	16.2	0.02	53.7	3
80,000	668	7.0	6.0	98	4.6	6.3	0.0	44.0	2.7
120,000	1000	7.0	6.0	98	4.9	4.5	0.0	41.5	2.3
160,000	1335	7.0	8.0	110	5.8	38.3	0.1	48.3	4.6
200,000	1670	7.0	8.0	110	6.4	53.2	0.1	40.0	14.3

*Journal Series Paper of the N. J. Agri. Expt. Sta., Dept. of Sanitation, Rutgers University, New Brunswick, N. J. Presented before the Water, Sewage and Sanitation Div. of the Amer. Chem. Society in Atlantic City, N. J., April, 1947. Released for publication in *Water & Sewage Works.*

3. *Penicillin*

Strong spent broth was uniformly diluted to about 1,000 ppm. B.O.D. and applied at increasing dosages and increasing B.O.D. loadings. The average results obtained are shown in Table III. B.O.D. values below 5 ppm. were constantly obtained with B.O.D. loadings to 1,000 lb. per acre a day. Increased loadings to 1,400 lb. per acre per day resulted in clogging after about three weeks' operation and deterioration of the effluent. Although some nitrification was still in evidence.

5. *Yeast*

Yeast waste contains considerable amounts of phosphates as well as nitrogen, and differs in this respect from the slaughterhouse, sulfite and sugar wastes. Yeast waste is more like penicillin waste. The results obtained on increasing dosages and B.O.D. loadings are shown in Table V. Up to loadings of about 1,000 lb.

TABLE III
AVERAGE RESULTS OBTAINED WITH SAND FILTRATION OF SETTLED PENICILLIN WASTE (Spent Broth)

Dosage gpad.	Applied Effluent B.O.D. lb./acre	pH	NH_3-N ppm.	Total N ppm.	pH	NH_3-N ppm.	NO_2-N ppm.	NO_3-N ppm.	B.O.D. ppm.
20,000	167	7.0	67	90	7.4	1.0	0.48	20.7	3
40,000	334	7.0	67	90	6.7	15.0	0.03	46.5	3
60,000	500	7.0	25	71	6.8	13.5	0.24	6.0	4
80,000	668	7.0	13	44	7.7	0.14	0.0	0.2	3
120,000	1000	7.0	33	64	8.1	9.5	0.0	0.2	2.5
160,000*	1335	7.0	25	55	7.4	1.3	0.0	0.4	94.4

*After 20 days' run at high rate filter clogged.

Of interest is that nitrification decreased greatly after a loading of about 400 lb. B.O.D. per acre per day, whereas the B.O.D. in the effluent remained low. The color of the applied settled waste was about 250 and disappeared at lower applications. With applications of approximately 800 lb. per acre, some color returned (50), and with applications of about 1,000 lb. B.O.D. per acre, the color was about 100.

4. *Sulfite*

Sand filtration of sulfite liquor is probably not feasible in practice on account of the large volumes involved and the low nitrogen content of the waste, which make biological treatment difficult. The main reason why sulfite liquors were included in the various wastes used for experimentation was that the waste is soluble and organic in nature and notoriously difficult to treat to a high degree, resulting in low B.O.D. values in the effluent.

The question was raised whether the waste had inherent inhibiting characteristics or whether with suitable amounts of nitrogen added the waste could be oxidized in the same manner and to the same degree as other organic wastes. Results obtained with various dosages and increasing loadings are given in Table IV. From the results it is evident that very high reductions in B.O.D. percentages could be obtained with applications of 1,000 lb. B.O.D. per acre. Less than 40 ppm. B.O.D. were present in the effluent. Nitrification proceeded in the same manner as with other organic wastes. With loadings of 1,400 lb. B.O.D. per acre, the effluent began to deteriorate, although some nitrification was still in evidence.

5. *Yeast*

Yeast waste contains considerable amounts of phosphates as well as nitrogen, and differs in this respect from the slaughterhouse, sulfite and sugar wastes. Yeast waste is more like penicillin waste. The results obtained on increasing dosages and B.O.D. loadings are shown in Table V. Up to loadings of about 1,000 lb. of B.O.D. per acre, the B.O.D. values in the effluent were below 10 ppm. with a high degree of nitrification in evidence. At higher loadings the effluent deteriorated gradually and the filter became clogged after 18 days' continuous operation at the high loadings. Of interest again is the fact that the pH values of the effluent were low at B.O.D. loadings up to 400 lb. per acre, but that the nitrates in the effluent remained high.

6. *Candied Fruit*

Candied fruit waste contains large quantities of sugar and considerable amounts of sulfur dioxide used for preservation of the fruit. The waste contains insufficient nitrogen to sustain a balanced bacteriological flora. Sufficient nitrogen was added to the waste to provide a minimum of 1 ppm. nitrogen per 15 ppm. B.O.D. in the applied waste. The results obtained (Table VI) show that with daily B.O.D. loadings of about 1,000 lb. per acre the B.O.D. of the effluent was consistently below 5 ppm. Nitrification was very high at the lower loadings. With daily loadings of 1,400 lb. B.O.D. per acre the effluent deteriorated and the filter eventually clogged.

Discussion

Small-scale sand filters operated 8 hours a day and receiving six different kinds of industrial wastes, primarily organic in nature, show a uniformly high degree of purification and stabilization, with applications of at least 1,000 lb. of B.O.D. per acre a day. Since the sand filters were 2 feet deep, this is equivalent to 500 lb. B.O.D. per acre foot. Similar loadings on coarse-grained filters rarely, if ever, produce effluents with B.O.D.'s as low as those obtained from the sand filters. The stabilization accomplished, as indicated by nitrification, compares very favorably with that obtained in standard trickling filters.

With higher applications than 1,000 lb. B.O.D. per acre foot, the filters began to clog after some weeks of operation on account of the suspended material and the degree of purification decreased. When the top layers of sand (1-3 inches) were removed, the percentage B.O.D. removed and the degree of nitrification were restored to the original, indicating that the manner of operation is an important factor and that much higher loadings could be maintained if the accumulated suspended material were removed at intervals. In other words, a sand filter provided with proper back washing equipment, similar to that used in water filtration, would allow continuous application of considerably higher dosages or stronger wastes.

Applications of 500 to 700 lb. of B.O.D. per acre foot were made over periods of only 8 hours a day. With the higher applications the effluent became poorer after some weeks of operation. Experiments made to determine what the effect would be if the same high loadings were applied over a longer period during the day showed that the B.O.D. in the effluent was reduced. As examples, some average results obtained indicate the improvement:

	B.O.D. Loading lb./acre	Ppm. B.O.D. Effluent Dose 8 hrs.	Dose 20 hrs.
Yeast	1400	85	46
Sulfite	1400	246	41
Sugar	1400	45	24
Penicillin	1400	94	37

TABLE IV
AVERAGE RESULTS OBTAINED WITH SAND FILTRATON OF SULFITE LIQUOR

Dosage gpad.	Applied Effluent B.O.D. lb./acre	pH	NH_3-N ppm.	Total N ppm.	pH	NH_3-N ppm.	NO_2-N ppm.	NO_3-N ppm.	B.O.D. ppm.
20,000	167	7.0	66.5	66.5	5.2	6.0	0.2	26.0	35
40,000	334	7.0	66.5	66.5	7.4	5.8	0.2	23.6	37
60,000	500	7.0	60.0	60.0	7.5	3.5	0.05	19.0	32
80,000	668	7.0	60.0	60.0	7.5	4.7	0.0	19.0	25
120,000	1000	7.0	60.0	60.0	7.5	3.0	0.0	19.0	28
160,000*	1335	7.0	60.0	60.0	7.4	19.3	0.0	2.0	246

*After 21 days' high application filter clogged.

It is obvious that high loadings applied over longer periods during the day can be more effectively treated. Hence, in those cases where wastes are produced intermittently, storage and equalization for 24 hours to apply a rather uniform load over an extended time would reduce the sand bed area required, or produce a better effluent.

In water filtration the sand filters are covered continuously with a layer of water. When sewage effluents are treated by sand filtration it is common practice to flood the filters several inches deep and let the effluent seep through the filter. This method of application is repeated intermittently. In our experiments the filters were not flooded, but the liquids were applied continuously in a similar manner as application on trickling filters by rotary or movable distributors. In other words, although the application was continuous, only a portion of the filter received waste at a given time. From our experiments it appears that this method of application produces better results than intermittent flooding.

The results obtained and the observations made show definitely that sand filtration of relatively small quantities of settled strong organic wastes is feasible and practicable. Although very good results can be obtained with wastes such as sulfite liquor, the quantities of wastes involved would make it economically impractical to attempt obtaining extremely high B.O.D. reductions on sand filters.

Summary and Conclusions

Laboratory experiments were conducted over an extended period with a series of organic industrial wastes, including penicillin (spent broth), slaughterhouse, yeast (spent broth), latex (chewing gum), sulfite liquor, and sugar (candied fruit), utilizing sand filters about two feet deep. The wastes were settled prior to filtration to reduce the suspended solids contents. After settling, the strength of the wastes varied from 0 to 122 ppm. suspended solids and from 1,350 to 20,000 ppm. B.O.D. The sugar and sulfite liquor wastes contained insufficient nitrogen for rapid biological action. These wastes were fortified with ammonia in the form of ammonium chloride on the basis of about 1 ppm. ammonia to 15 ppm. B.O.D. Loadings were applied varying from 20,000 to 200,000 gal. per acre a day or from 167 to 1,735 lb. B.O.D. per acre per day. All settled wastes responded to sand filtration. Loadings up to 1,000 B.O.D. per acre a day, applied over an 8-hour period, of slaughterhouse, penicillin and candied fruit wastes produced effluents with less than 5 ppm. B.O.D.; similar loadings of yeast waste produced effluents with less than 10 ppm. B.O.D., and sulfite and digested latex less than 40 ppm. B.O.D. Nitrification was high and varied with the loadings. Color removal was effective in all cases except at very high loadings.

Extending the applications to 20 hours during the day allowed loadings to be increased, or with high loadings produced a better effluent than application over an 8-hour period.

Excessive applications caused clogging of the filters. Removal of the top layer of sand or replacement of the surface sand, a procedure comparable to back washing, relieved clogging at high rates of application.

The filters were not flooded with the waste, but the liquids were applied continuously, which is in principle similar to waste application on coarse grained trickling filters by rotary or movable distributors.

In general, the method of sand filtration of strong organic wastes would require equalization of flow and settling prior to filtration. The sand filters would require back washing facilities and even distribution of the wastes over the surface with avoidance of flooding.

TABLE V

AVERAGE RESULTS OBTAINED WITH SAND FILTRATION OF SETTLED YEAST WASTE (Spent Broth)

Dosage gpad.	Applied Effluent B.O.D. lb./acre	pH	NH_3-N ppm.	Total N ppm.	pH	NH_3-N ppm.	NO_2-N ppm.	NO_3-N ppm.	B.O.D. ppm.
20,000	167	7.0	48	132	3.8	9.3	0.28	75.7	6
40,000	334	7.0	48	132	3.7	31.5	0.08	42.0	8
60,000	500	7.0	44	117	3.7	27.2	0.10	46.5	6
80,000	668	7.0	16	121	6.4	5.7	0.10	34.0	7
120,000	1000	7.0	16	121	6.7	10.0	0.06	27.0	12
160,000	1335	7.0	16	121	6.9	16.3	0.02	9.7	85*

*After 18 days' operation effluent deteriorated.

TABLE VI

AVERAGE RESULTS OBTAINED WITH SAND FILTRATION OF SETTLED CANDIED FRUIT (Sugar) WASTE

Dosage gpad.	Applied Effluent B.O.D. lb./acre	pH	NH_3-N ppm.	Total N ppm.	pH	NH_3-N ppm.	NO_2-N ppm.	NO_3-N ppm.	B.O.D. ppm.
20,000	167	7.0	85	115	4.5	26.7	0.48	32.0	2
40,000	334	7.0	85	115	3.6	35.8	0.10	19.8	3
60,000	500	7.0	65	80	3.6	27.2	0.10	46.5	4
80,000	668	7.0	60	73	7.0	26.3	0.0	15.7	2.3
120,000	1000	7.0	60	73	7.7	35.0	0.0	6.0	1.3
160,000*	1335	7.0	60	70	6.7	39.6	0.0	0.8	45

*After 20 days' high application filter clogged.

A Common Packing Problem

Expansion of packing commonly causes trouble. Thus when a packing gets hot its volume increases, which in turn makes the packing too tight, thereby interfering with the movement of the piston rod, valve stem shaft, or whatever it is that is packed by the packing.

Obviously, the best possible remedy for a condition of this kind is to use a packing that neither expands nor contracts on heating or cooling.

It seems that many users of packings are not aware of the existence of such non-expanding packings on the market. For instance this writer knows of a metallic packing that is based on a metal possessing the desirable property of expanding upon cooling and contracting upon heating. In conjunction with the other materials in the packing it is therefore an ideal substance because it produces a packing which in total volume neither increases nor decreases regardless of the temperature. It withstands temperatures up to 1200 deg. F., and it resists corrosion from acids, alkalis, and electrolysis.

Years ago it was thought by many of us that packings could not be improved. We thought we had the "last word" in packings. But, surprising as it may seem, improvements are being made right along, and the writer believes they will continue to be made for many years to come—as long as human beings are capable of thinking constructively.

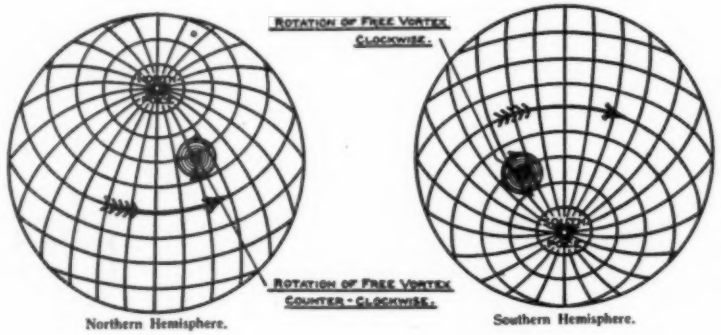
Contributed by W. F. Schaphorst, M.E., Newark, N. J.

Comments of the Editors

More Concerning the Puzzling Vortex

Some of our readers will recall comments on this page of our November, 1946, issue relating to the puzzling behavior of those swirling vortices which form above submerged outlet pipes from reservoirs, tanks, basins, and the like. With the understanding that the vortex normally swirls in a clockwise direction in the Southern Hemisphere and counter clockwise in the Northern Hemisphere, we posed the question as to what happens to the vortex at the Equator?

As the result of these comments, which evidently revealed vast ignorance concerning vortex action in general and how a vortex on the "Big Circle" could determine in which direction to swirl, we have received a number of enlightening and interesting comments from readers. The following comprises some of the highlights from the information received, accompanied by excellent photographs of vortices in both hemispheres to prove that the swirling spiral assumes opposite directions north and south of the Equator. The generally accepted explanation of this phenomena is that the rotation of the earth and the resultant centrifugal effect is the underlying force which determines the direction of vortex swirl, but more about this later.



One of the most formidable vorticular manifestations is the well known and awesome water spout which usually occurs over tropical seas, and is most usually pictured with the spiral swirl in a counter clockwise direction. The well known smoke ring also represents vorticular motion.

Vortex motion, first described by Venturi in 1797, constitutes one of the types of fluid motion upon which modern mathematical theory of fluid mechanics is based, the other two being streamline motion and wave motion. It is a fact that free vortex motion involves the smallest possible loss of energy and therefore is Nature's own arrangement. On the other hand, the destructive energy in great volumes of falling water can be rapidly dissipated by discharging the water in a spiral jet from such outlets as syphon spillways. A proprietary device for obtaining this effect on dam outlets is the Glenfield Jet Disperser marketed in Scotland.

Of especial interest to water and sewage works men and power plant operators is the fact that the discharge capacity of pipes and conduits is very markedly diminished when a vortex forms—and the simplest scheme of vortex elimination is the insertion of a baffle within the mouth of the discharge pipe, thus converting the circular outlet into two semi-circular outlets. The writer has effectively employed a spider-baffle (water wheel effect) which resulted in four pie shaped outlets instead of the vortex creating circular outlet. One correspondent reports that a floating ball of same size or a raft anchored above the pipe entrance will dissipate the vortex funnel. One states that vortices form most readily when the head over the outlet orifice becomes less than about three times the diameter of the orifice.

A new vortex theory has been propounded by the British engineer O. A. Price, in which a centrifugal pump is likened to a hollow flowing vortex, and the notion of "slip" is introduced to explain the discrepancy between the accepted theory of the centrifugal pump and its actual performance. In addition, one writer states that the question of vortices becomes much more than academic when it is realized that *all* flow which is not streamline flow is accompanied by the production of vortices. An example of this effect may be observed in mixing chambers at purification plants and may well exist in pipe lines also.

For an interesting explanation of the reason for the vortex taking on a clockwise direction south of the Equator and counter clockwise direction north of the equator we are indebted to N. Zinder, chief engineer of Glenfield and Kennedy, Ltd., of Kilmarnock, Scotland, who has sent us a copy of a brief article by E. Bruce Hall, which appeared in *The Engineer* for June 30th, 1933. From Mr. Hall's contribution the accompanying illustration has been taken. His explanation favors the gyroscopic effects arising from the earth's rotation as the cause of the seemingly opposite rotations of the vortex in the two hemispheres. But one will say that the earth operates in but one direction—what then? A study of Mr. Hall's sketch reveals that in both cases the rotation of the vortex above and below the Equator is really in the same sense as the rotation of the earth, but when viewed from the opposite sides of the world the *apparent* directions of rotation are naturally reversed.

What, then, happens at the Equator? Nothing—for all observers agree that if only the natural effects come into play there can be no vortex at the Equator. This perhaps will not satisfy one of our correspondents who reports that following his bath on ship-board while crossing the "Big Circle" the swirl over the drain outlet started counter clockwise, hesitated, and then swung around to the clockwise direction. Our observer concluded that the "Equatorial Vortex" seemed as much puzzled as was the editor when he propounded the $64 question in his November, 1946, issue.

To those interested in further pursuing the theory and behavior of the vortex we suggest reading the chapter, "Free Cylindrical Vortex Motion," in the Encyclopedia Britannica and the chapter on "Types of Vortices" in Vennaid's "Elementary Fluid Mechanics."

L. H. Enslow

50th Anniversary—1897-1947

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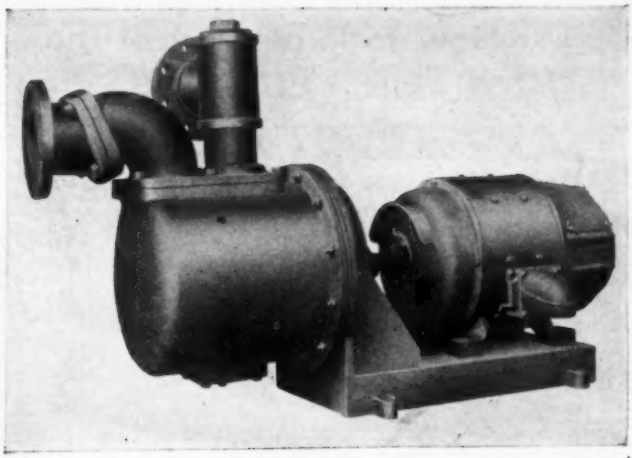

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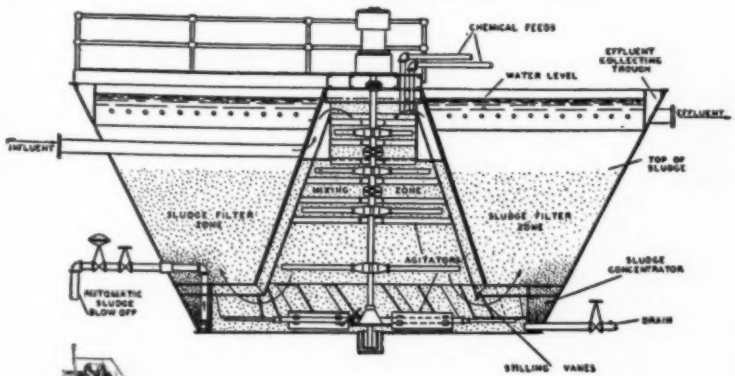

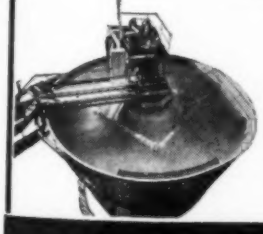

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MEETINGS SCHEDULED

Sept. 16-19—BOSTON, MASS. (Statler Hotel)
New England Water Works Assn. Sec'y, Jos. C. Knox, 609 Statler Bldg., Boston, Mass.

Sept. 17-19—ATLANTA, GA. (Ga. School of Technology)
Annual Water & Sewage School. Sec'y, Van P. Enloe, Rt. 5, Box 363, Atlanta, Ga.

Sept. 18-19—WATERTOWN, S. D. (Lincoln Hotel)
South Dakota Water & Sewage Works Conference. (13th Annual Meeting.) Secretary, W. W. Towne, State Dept. of Health, Pierre, S. Dak.

Sept. 18-20—BAY CITY, MICH. (Wenonah Hotel)
Michigan Section A.W.W.A. Sec'y, R. J. Faust, State Dept. of Health, Lansing, Mich.

Sept. 22-24—LOUISVILLE, KY. (Brown Hotel)
Kentucky-Tennessee Section A.W.W.A. Sec'y, R. P. Farrell, 420 6th Ave., N., Nashville 3, Tenn.

Sept. 25-26—DENVER, COLO. (Cosmopolitan Hotel)
Rocky Mountain Section A.W.W.A. Secretary, O. J. Ripple, 710 Colorado Bldg., Denver, Colo.

Sept. 25-26—GRAND FORKS, N. D. (Dacotah Hotel)
North Dakota Water & Sewage Works Conference. Nineteenth Annual. Sec'y, R. M. Jensen, Supt., Grand Forks, N. D.

Sept. 30-Oct. 1—COLUMBUS, OHIO (Deshler-Wallick Hotel)
Ohio Section A.W.W.A. Sec'y-Treas., F. P. Fischer, 812 Perry Payne Bldg., Cleveland, Ohio.

Oct. 2-3—COLUMBUS, OHIO (Deshler-Wallick Hotel)
Ohio Conference on Sewage Treatment. Sec'y-Treas., L. B. Barnes, 441 S. Prospect St., Bowling Green, Ohio.

Oct. 2-3—BLUEFIELD, W. VA. (Hotel West Virginian)
West Virginia Section A.W.W.A. Sec'y, J. B. Harrington, State Department of Health, Charleston, W. Va.

Oct. 5-8—JACKSONVILLE, FLA. (Hotel not selected)
American Public Works Association. (Annual Meeting) Exec.-Dir., D. F. Herrick, 1313 E. 60th Street, Chicago, Ill.

Oct. 6-8—NIAGARA FALLS, ONTARIO (General Brock Hotel)
Canadian Institute on Sewage & Sanitation. Sec'y-Treas., A. E. Berry, Ontario Department of Health, Toronto 8, Ont.

Oct. 6-10—ATLANTIC CITY, N. J. (Convention Hall)
American Public Health Association. (75th Annual Meeting.) Exec.-Sec'y, Reginald M. Atwater, M. D., 1790 Broadway, New York, N. Y.

Oct. 8—DOVER-FOXCROFT, ME.
Maine Water Utilities Assn. Sec'y, Earle A. Tarr, Winthrop, Me.

Oct. 8-10—ATLANTIC CITY, N. J. (Haddon Hall)
Pennsylvania Water Works Association. Sec'y-Treas., E. R. Hannum, 510 Telegraph Bldg., Harrisburg, Pa.

MEETINGS SCHEDULED

Oct. 9-11—CEDAR RAPIDS, IOWA (Hotel Montrose)
Iowa Section A.W.W.A. Sec'y-Treas., H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.
(Joint meeting with)
Iowa Sewage Works Assn. Sec'y-Treas., Robert D. Mott, Iowa City, Iowa.

Oct. 13-15—AMARILLO, TEXAS (Hotel Herring)
Southwest Section A.W.W.A. Sec'y-Treas., L. A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 16-17—OCEAN VIEW, VA. (Hotel Nansemond)
Virginia Industrial Wastes & Sewage Works Assn. (First Annual Conference). Sec'y-Treas., A. H. Paessler, 815 E. Franklin St., Richmond 19, Va.

Oct. 16-17—HARRISBURG, PA. (Hotel Harrisburger)
Penna. Municipal Authorities Association. (5th Annual Conference). Sec'y-Treas., Claude E. Fogelman, 1717 Main St., Northampton, Pa.

Oct. 23-25—MILWAUKEE, WISC. (Hotel Schroeder)
Wisconsin Section A.W.W.A. Secretary, L. A. Smith, Supt. Water Works, Madison, Wisc.

Oct. 27-28—JEFFERSON CITY, MO. (Governor Hotel)
Missouri Section A.W.W.A. Missouri Water & Sewage Conference. Sec'y-Treas., W. A. Kramer, State Board of Health, State Office Bldg., Jefferson City, Mo.

Nov. 3-5—ATLANTA, GA. (Biltmore Hotel)
Southeastern Section A.W.W.A. Sec'y, W. T. Linton, State Board of Health, Wade Hampton Office Bldg., Columbus, S. C.

Nov. 6-8—ATLANTIC CITY, N. J. (Hotel Claridge)
New Jersey Section A.W.W.A. Sec'y-Treas., C. B. Tygert, Box 178, Newark, N. J.
(Joint meeting with)
South Jersey Assn. Water Supts. Sec'y, Walter Spencer, 2707 Bethel Ave., Merchantville, N. J.

Nov. 10-12—GREENSBORO, N. C. (Sedgfield Inn)
North Carolina Section A.W.W.A.
North Carolina Sewage Works Association. Sec'y-Treas., Geo. S. Moore, P.O. Box 125, Albemarle, N. C.

Nov. 12-14—PITTSBURGH, PA. (Hotel Wm. Penn)
Engineers' Society of Western Penna. (8th Annual Conference) Gen. Chairman, H. M. Olson, Wm. Penn Hotel, Pittsburgh, Pa.

Nov. 17-18—ROANOKE, VA.—(Hotel Roanoke)
Virginia Section A.W.W.A. Sec'y-Treas., W. H. Shewbridge, 708 State Office Bldg., Richmond, Va.

Nov. 19-21—WASHINGTON, D. C.—(Wardman Park Hotel)
Four States Section A.W.W.A. Sec'y-Treas., W. A. Welch, 748 Public Ledger Bldg., Philadelphia, Pa.

Nov. 20—BOSTON, MASS. (Statler Hotel)
New England Water Works Assn. Sec'y, Jos. C. Knox, 609 Statler Bldg., Boston, Mass.

Nov. 20-22—ST. PETERSBURG, FLA. (Suwannee Hotel)
Florida & Cuban Sections A.W.W.A. (Joint Meeting) Sec'y Fla. Section, A. P. Black, University of Florida, Gainesville, Fla., Sec'y Cuban Section, Laurence H. Daniel, Box 531, Havana, Cuba.

Dec. 10—WINTHROP, ME.
Maine Water Utilities. Sec'y, Earle A. Tarr, Winthrop, Me.

Dec. 18—BOSTON, MASS. (Statler Hotel)
New England Water Works Assn. Sec'y, Jos. C. Knox, 609 Statler Bldg., Boston, Mass.

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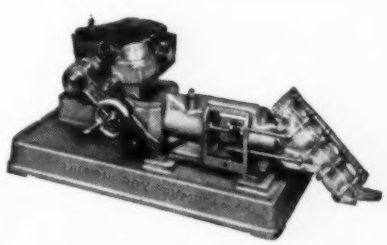

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Here and There with Doc Symons

Council Bluffs, July 30 (Delayed)—H.T.M.A.—And this month I shall try to recreate my impressions of the concurrent conventions of the A.W.W.A. and F.S.W.A. in San Francisco in July. Those of you who saw or experienced the same things I did may find this column a jog to pleasant memories. Those of you who went elsewhere, did otherwise, or saw other things, will I hope, recall your own experiences as you read mine. But it is really for you who were not there that I write this particular column. If, for one fleeting instant, I can spark your imagination to transport you to those conventions, then I shall consider both my trip and this monthly letter a complete success.

* * *

The Trip Out began Thursday evening in Penn Station in little old New York. There was the 15-minute wait in the train concourse while commuters scurried by to catch that all-important 5:42 local-express; there was the hasty trip to follow the red cap down to the platform as the train pulled in, and the discovery that he had taken me to the wrong end of the train; there was the final location of my car, not quite as old as the man for whom it was named, Shakespeare; yes Shakespeare, our home on wheels for the next seventy-two hours; there was the discovery of the Jake VanAtta's, the Dan Saunders', and Harry Beohner; and then the train began to move, slowly at first, then more rapidly as we plunged into the tunnel under the Hudson River and began to span this great continent.

A few minutes later, in Newark, we picked up Attmore Griffin, my travelling companion and room-

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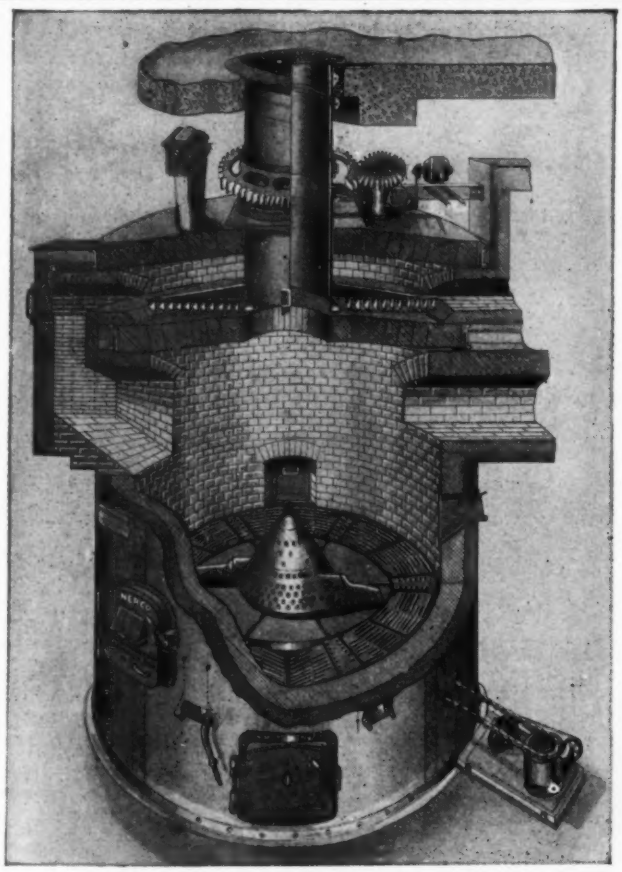

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mate for the trip and Sam Newkirk who boarded the car ahead of us. In Paoli, Pa. (where all trains stop) the Casey Jones' came aboard, and at Chicago the Wendell LaDue's joined our Shakespeare party. Others on the train as we left Chicago were the Lou Howsons, Rollo Blanchard, Joe (Red Hed) Lufkin, the Fred (Joe) Reny's of Portland, Me., Jerry Zufelt of Sheboygan, and sometime that night Andy Veatch and others from Kansas City hooked a car on the train as did the Clifford Fore's (formerly of Carbondale, Ill., now of Robinson), and others whose names escape me at the moment. By the time we reached S. F. there must have been twenty-five of us.

* * *

Next Stop—Council Bluffs! Every trip of this kind is bound to have a running gag, usually perpetrated and perpetuated by some prankster addicted to puns. We were no exception. At our second stop out of New York, Jake Van Atta called out, "Next Stop—Council Bluffs," and from then on, no stop was sacred and no hour too late—or early, too, for "Next Stop—Council Bluffs" to ring through the length of the car in stentorian bass or high soprano. Even the other passengers and the trainmen "got into the act." Naturally, the Oakland-San Francisco ferry docked at "Last Stop—Council Buffs" and of course I couldn't resist the temptation to begin this letter in "Council Bluffs."

There were other gags, puns galore, the episode of presenting Harry Beohner's "hand made" ties (they really were hand made) to the train waiters, our own porter whose name of Clearfield Fisher gave rise to all sorts of weird puns but whose service was worth writing to the Pullman company about. There were the dirty water bottles on the diner at breakfast that first morning out of New York; there was that five hour wait in Chicago when everyone rushed off to see some one, to do some shopping, or to call the office. We all must have been anxious to get on with the trip for, fully an hour before train time our little group had gathered at the station. That night (Friday) we saw for the first time that wonderful train waiter who was to carry all of our meals for the next two days. Not that carrying meals on a train is so wonderful, but John carried them on his head. Making a small donut from a napkin, which he placed on his head, and on which in turn he set a tray full of meals tied in a table cloth, John scooted through several cars from the diner, scarcely ever touching a steadying finger to the tray as he opened doors, passed passengers or rapped at compartments, to deposit his burden; (It was truly wonderful); there were the other thousand little things we shared and experienced together, that flash before the mind, and there were—

* * *

The Big Things—the seemingly mile after mile of unending sage brush, the first glimpse of the mountains, Granite Canyon, Sherman Hill (Elev. 8013 feet), Great Salt Lake, and beautiful Donner Lake and Donner Pass.

I shall not forget that it was Mrs. Lou Howson who first called my attention to the distant mountains

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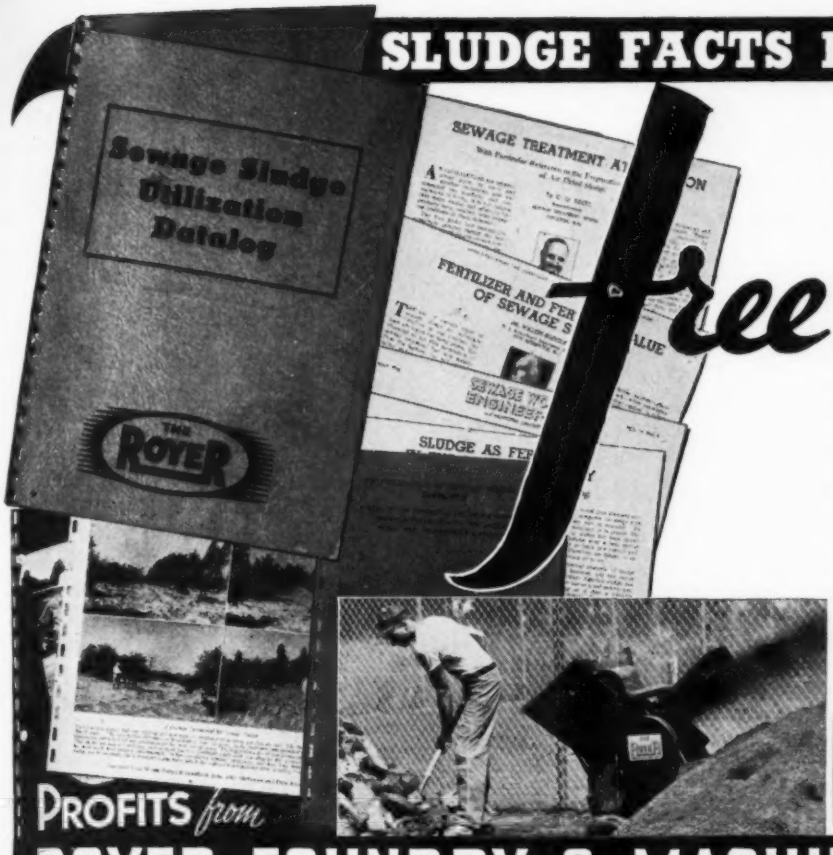
SLUDGE FACTS FROM EXPERTS



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Size ⅛" to 40", lightweight, Standard, X Heavy, XX Heavy and Irrigation Pipe.

Steel Plates, Bars and Rounds, Welding Supplies, Construction and Mining Equipment and Supplies. Hi-Speed Drills, Electric Motors and Accessories. Many Other Items.

We Purchase and Dismantle Refineries and Pipe Lines

LAWRENCE PIPE COMPANY

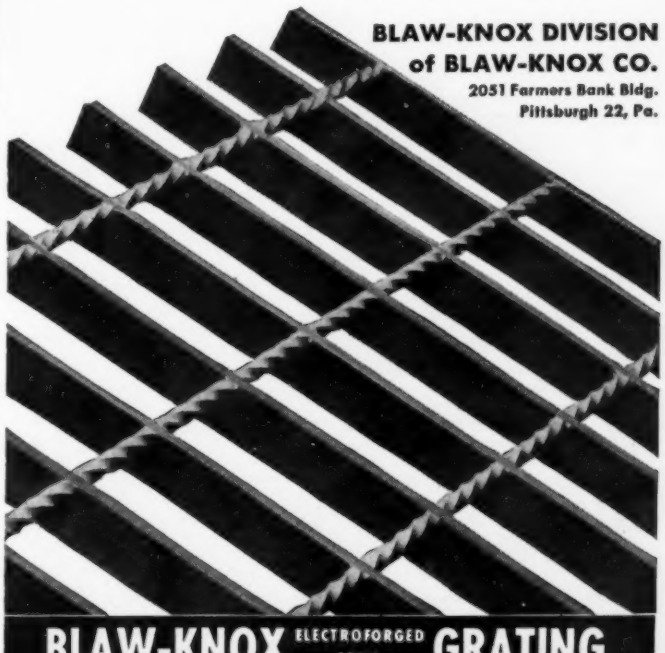
5030 LONG BEACH AVE • LOS ANGELES 11, CALIF • Kimball 1234

5 GOOD REASONS

for buying Blaw-Knox Grating . . . COUNT 'EM!

1. STRONG electroforged construction for easy erection.
2. MAXIMUM OPEN AREA for light and air.
3. EASY TO MAINTAIN . . . paint reaches entire surface.
4. SELF-CLEANING, no sharp corners to clog.
5. SAFE footing at all times with twisted cross bar.

BLAW-KNOX DIVISION of BLAW-KNOX CO.
2051 Farmers Bank Bldg.
Pittsburgh 22, Pa.



BLAW-KNOX ELECTROFORGED STEEL GRATING

with snow near the peaks. It was my first view of anything higher than the Allegheny's and I was not disappointed—Later that morning (it was Saturday now; we had slept through the tilled fields of Iowa, including Council Bluffs, and Nebraska), we stopped at Cheyenne, Wyo. where we acted like millions of other tourists, taking pictures, buying trinkets at twice their value, and sending our share of the $25,000,000 worth of post cards that are mailed each year in this country.

It was in Cheyenne that I picked up a piece of ice to slip to some unsuspecting companion via a handshake, and then watch it pass from hand to hand until it expired between the palms of two past presidents of A.W.W.A., Sam Newkirk and Wendell La Due (technically La Due was a past president as of July 1).

That afternoon some twenty or more of us gathered in the club car for a cocktail party as guests of Rollo (Neptune Meter) Blanchard. Of course, Rollo didn't know he was to be the host until after Dan (Permutit) Saunders had invited all waterworks people on the train. I must report that Rollo was a perfect host. (By the way, it was Rollo's Pullman porter who saw his ASCE pin, recognized it as like one he had found in another car, and so I got my pin back nearly thirty-six hours after I first missed it.)

* * *

It isn't really enough, just to make passing mention of the passing scenes but after a time one became used to the mountainous skyline, the always present sage brush, the occasional small group of cattle, and the infrequent groups of huts and small houses all painted in the possessive color of the Union Pacific. One thing kept repeating itself in my consciousness—a repetition almost with the insistency of the monotonous click of the train wheels—and that one thing was the lack of water. To men whose life's work is to bring water to their fellows, the importance of water to life and living has always been paramount—yet here, for mile after mile, hour after hour, was dramatic proof of the fact that without water there *is* no life.

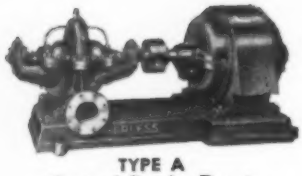
Running somewhat late, we rolled into Ogden, Utah, in the twilight and more post cards were dispatched, most of them with a small bag of salt attached. An hour later, it was dark as we crossed the Great Salt Lake. Only by turning out the lights in the car could we see that remnant of a once mighty inland ocean, now but a strong solution of salt, ten times saltier than the seven seas and with only some very tiny shrimp as its inhabitants. Without a moon, it looked dark and foreboding, stretching away in the distance toward Salt Lake City. We went to sleep.

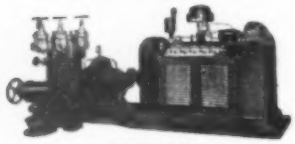
* * *

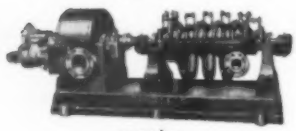
Sunday morning we arrived in the Biggest Little City in America. That would be Reno, where—need I tell you?—We didn't stop long enough to try our luck at roulette, chuck-a-luck, or chemin de fer. In fact our stop was so short, that two girls (Dot Jones and Lil Saunders) had to run to get back on the train as it pulled out—or maybe at the last minute they changed their minds about a six weeks' residence there.

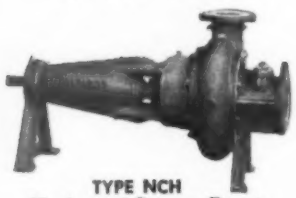
Whatever Reno may think of itself, our group was far more in-

Where there's a PUMP in your Plan
SPECIFY
PEERLESS


TYPE A
General Service Pump


TYPE AF
Fire Pump Underwriters' Approved


TYPE B
Boiler Feed Pump


TYPE NCH
Horizontal Sewage Pump

PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
Factories:
Indianapolis, Ind. • Quincy, Ill. • Los Angeles 31, Calif.
District Offices: Canton 2, Ohio; Philadelphia: Suburban Square, Ardmore, Pa.; Atlanta: Rutland Bldg., Decatur, Ga.; Dallas 1, Tex.; Los Angeles 31, Calif.

PEERLESS CENTRIFUGAL PUMPS ARE MANUFACTURED IN AN EXTENSIVE SERIES OF ADVANCED TYPES, SIZES AND CAPACITIES UP TO 70,000 G.P.M.

For diversified, heavy-duty services in Municipalities and Waterworks, Peerless centrifugal pumps incorporate many proven design features for extended pump life, minimum down-time and operative economy.

GENERAL SERVICES
Peerless type A pumps afford top-flight, continuous duty operation with capacities from 50 to 70,000 g.p.m. Heads: 15 to 300 ft. All types of drives: 1 to 1000 h.p. Sizes: 2" to 42" discharge. Split-case, single stage, double suction type.

FIRE PUMPS
Peerless Underwriters' Approved fire pumps are available for all fire protection services. Capacities: 500 to 2000 g.p.m. Pressures: to 150 lbs.; single and double stage types, for electric, engine, turbine drive or combinations.

BOILER FEED
Peerless type B multi-stage pumps are for Boiler feed services requiring capacities of 50 to 900 g.p.m. and handling pressures up to 700 lbs. For electric and other type drives from 60 to 350 h.p.

SEWAGE AND RE-LIFT
Peerless Non-Clog type NCH pumps are designed for dry basin installation in capacities from 100 to 7000 g. p.m. Heads: 12 to 70 ft. All types of drives: 1 to 100 h.p. Unique repelling shroud vanes utilized for a most dependable method of pumping entrained solids. Vertical type also available.

PEERLESS PUMPS
FOR MOST SERVICES IN ALL INDUSTRIES

Dependable!
Rugged!

VALVES
HYDRANTS

M & H Flap Valve

VALVES: A.W.W.A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position. All rugged and dependable, made of best material with highest quality workmanship.

Hydraulically Operated: For remote control of operation and for quicker, easier opening or closing. Can be supplied in any of the standard sizes of M & H A.W.W.A. gate valves, either high or low pressure.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals. Dry top, revolving head, easy to lubricate. High efficiency because barrel diameter not reduced and there are no working parts or obstructions in waterway. SPECIAL TRAFFIC MODEL is designed to yield at ground line under impact, repair being simply renewal of breakable bolts and breakable coupling on stem.

M & H Shear Gate

Write for Catalog No. 34

M & H PRODUCTS INCLUDE

FIRE HYDRANTS
GATE VALVES
TAPPING VALVES
WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

M & H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

Hooker Chlorine
A Multipurpose Chemical in Sewage Treatment

You who have the responsibility of sewage disposal as well as water sterilization will find Hooker Chlorine a multipurpose ally in making your work easier and your results better.

Sewage officials are using chlorine in many phases of sewage treatment to good effect. Chlorination of effluent is not only reducing bacteria count, but where residual is maintained at 0.5 to 1.5 ppm, indications are that there is a decided improvement in the quality of the water in which the effluent is discharged.

Stabilization of raw sewage, odor control, prevention of filter ponding and increasing filter bed efficiency, improvement of sedimentation and sludge digestion are other operations in sewage treatment where chlorine is being successfully used.

Hooker chlorine whether for sewage treatment or for water sterilization, is of the same uniform high quality that has been protecting water supply for over a quarter of a century. Hooker's Technical Staff, too, is at your service on problems involving the handling of chlorine and the other Hooker Chemicals. For assurance of consistent high quality specify Hooker Chlorine.

HOOKER ELECTROCHEMICAL COMPANY

Buffalo Ave. & Ward St.
Niagara Falls, New York

New York, N. Y. . Tacoma, Wash.
Wilmington, Calif.

HOOKER CHEMICALS

Chlorine
Caustic Soda Muriatic Acid

2829

terested in the Truckee River, and the occasional green spots along its meandering course. Then came Truckee itself and then—the Donner Pass. *That* was something. Shakespeare's inhabitants, none of whom had ever gone that way before, were glued to the windows as we wound our way around mountain peaks, through tunnels, and under snow sheds.—Far below us, lay a beautiful turquoise jewel, Donner Lake, named for that hardy band of pioneers whose trek across this country is now a saga of American history.

From there on it was downhill all the way, with stops at Sacramento, Berkeley and finally Oakland Pier. By then we were tired, felt the need of a bath, and were ready to get rid of the sensation of constant motion, but there was yet the trip across the bay on the ferry. As if to welcome us, a seal splashed by and a sea gull soared overhead as we crossed under Bay Bridge and headed for ———

Fabulous San Francisco, with its seven hills and its famous history. It was all one could have imagined —the ride on the pride of every San Franciscan's heart, the cable car (with the motorman playing an insistent tune on the bell)—the trip through China Town, where before the war, most shops were owned by Japanese—a delightful summer temperature reminiscent of the best August days in Buffalo, N. Y. (not this year)—no fog—the old men lounging in the sun on Union Square, beneath which, a subterranean parking lot each morning swallows hundreds of automobiles to disgorge them, come five p.m.—The Hawaiian boys just flown in with leis about their necks —Powell and Market Sts., which had a distinct flavor of Times Square and 42nd St. N. Y. C.—Fisherman's Wharf—Dinner with my San Francisco friends, the Harvie Freeds, at Julius Castle, high on the Embarcadero side of Telegraph Hill—from which, as I ate, I watched the lights wink on in Oakland, Berkeley, Richmond and Alcatraz—the ride past the Golden Gate Bridge and the Presidio—a visit to a typical San Francisco Spanish type house, 25 ft. wide with an open air patio in its middle—Famous old Mission Dolores, opened now only for weddings, I'm told—and as final exciting climax to a tour of the city, the breathtaking view of San Francisco at night, from Twin Peaks. There with low scudding wisps of clouds not far above my head and a cool stiff night breeze rumpling my few remaining golden locks—there, I felt that the world was at my feet; fabulous, sparkling, twinkling, historic San Francisco, gateway to a continent, on one hand and on the other, that wonderful Golden Gate to the enigmatic and ancient Orient.

Of course, it was an unforgettable experience to look out on the city from the "Top of the Mark," but it is high on top of Twin Peaks, where no houses now stand, that I shall build my home, if only in my dreams.

* * *

So much for this letter—it's too long already—but I haven't yet told you of my impressions of eating places, or the places I didn't go, and of course the two conventions and Mike Glace's bridge playing on the trip back.—If you'd like to hear the rest of the story next month, drop me a line. V.T.Y.—Doc.

K-1014 New Code Washington Pattern, Inverted Key Hydrant Stop and Drain with combined cap and tee. Inside iron pipe threads.

Efficient Operation Longer Service proves Glauber BEST

K-1012 Cap Pattern Hydrant Stop and Drain with loose tee handle, and inside iron pipe threads.

For reliable, trouble-free water line systems, install Glauber ground keys and stops. Glauber quality is proven quality—a result of Glaubers' vast experience in ground key design and manufacture. When laying extensions or new mains, specify Glauber stops and fittings—they'll last the life of any installation.

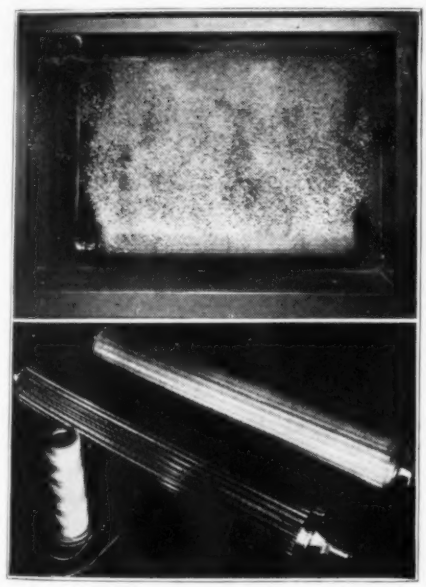
THE Glauber BRASS MFG. CO., KINSMAN, O.
Division of H. B. SALTER MFG. CO., Marysville, Ohio

Glauber RED BRASS
GROUND-KEY CURB and CORPORATION STOPS
LEAD GOOSENECKS and WATERWORKS FITTINGS

MANUFACTURERS' and EQUIPMENT NEWS

New Air Diffuser Tube

Chicago Pump Co., 2349 Wolfram St., Chicago 18, Ill., has introduced the new Chicago "Precision" Diffuser Tube. The diffusing surface of the Precision Diffuser Tube is of Saran (plastic) twisted cord which provides uniform thin-wall interstices for fine-bubbled diffusion. This cord is mechanically wound on a stainless steel core and firmly anchored at each end with blind rivets.

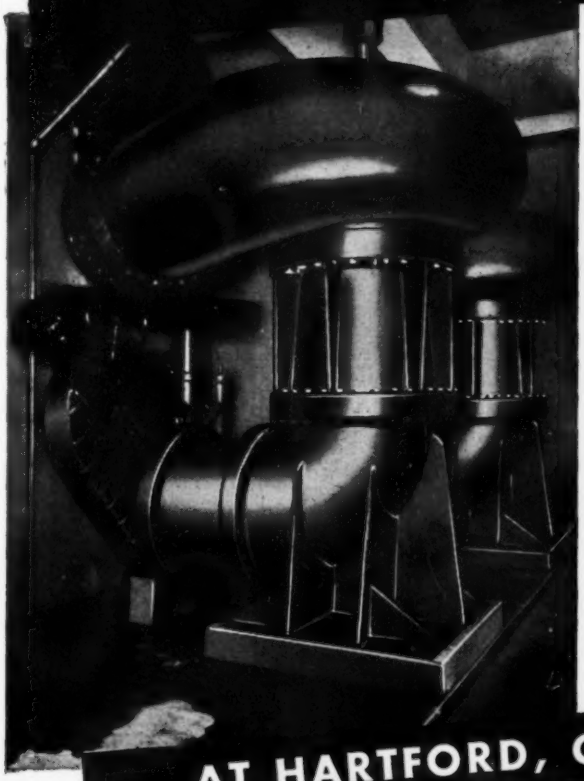


Air distribution to the diffusing surface is effected through large multiple outlets in the valleys of the corrugations. This Precision Diffuser Tube weighs approximately 3½ lbs.; 60 per cent lighter than the previous standard.

The new diffuser tube is designed for use with the Chicago Swing Diffuser equipment, has a low head loss over the entire range of air rate and develops a precise uniformity of fine-bubbled diffusion from the entire active surface of the diffuser regardless of variations of air rates. The tubes may be easily cleaned.

Further information is contained in Bulletin 177.

This *Giant* Morris Pump has operated for 17 years . . . and still going strong!



● **In city after city . . . in one installation after another . . . municipal engineers prefer Morris Pumps for economy . . . easy maintenance . . . and long term service.**

In Hartford, Conn., Morris Pumps were installed in one station after another . . . and after years of service, *are still going strong!*

AT HARTFORD, CONN.

1. The South Meadows Drainage Pumping Station, constructed in 1830, pumps storm water from a 1000 acre tract. It uses four 36" volute type screw impeller Morris Pumps (as illustrated). Each pump has a capacity of 30,000 GPM at a 20' head . . . and uses a 225 HP synchronous motor. **These Morris Pumps have been in continual service for 17 years.**

2. The Avon Street Pumping Station built in 1938 as part of the intercepting sewer system for the Hartford Metropolitan Area, is fully automatic. As a lift station, it uses two 12" x 10" Morris sewage pumps, each with a capacity of 1800 GPM at a 13' head and each driven by a 10 HP variable speed motor. **These Morris pumps have been in continual service for 9 years.**

3. The Potter Street Lift Station was constructed in 1939 to lift sewage from one trunk sewer to another. It is using two Morris 14" x 12" sewage pumps with fully automatic control. Their capacity is 3,000 GPM each at a 10' head, efficiently driven by 15 HP motors. **These Morris Pumps have been in continual service for 8 years.**

● **The Morris Pumps in these three stations prove once again what Morris Engineers have long believed to be true: a pump is never obsolete so long as it operates efficiently, economically and dependably.**

Write today for specifications and operation data on pumps to fit your particular needs. Our recommendations are based on 83 years of pump-building experience.

MORRIS MACHINE WORKS • Baldwinsville, N.Y.
Sales Offices in Principal Cities

MORRIS CENTRIFUGAL PUMPS

Pittsburgh Eric Process for Pipe Lining

Interest continues to grow in the Pittsburgh Eric Process for lining cast iron pipes in place. This new process was introduced in this country by the Pittsburgh Pipe Cleaner Co. of 133 Dahlem St., Pittsburgh 6, Pa.

The process consists of depositing bitumen (called Lectumen) lining on a pipe wall by electrolytic deposition similar to metallic plating. Before the lining is deposited, the pipe must be cleaned, but on clean pipe the new lining can be deposited on any pipe from 3 to 24 in. in size up to 1,000 ft. in length; 45 deg. ells do not have to be removed, but best results are obtained if 90 deg. ells are removed. It is not necessary to remove corporation cocks, and the length of time required to do the job is not great.

This bitumen coating which is resistant to water and chemicals which are found in water lasts for long periods of time. Experimental installations have shown life of greater than 10 years. The cost of lining pipe by this method is dependent on the size of the pipe, depth underground, working conditions, and in short, the conditions of each particular job.

Further information is available on request.

Hopkins Executive Vice Pres. R-S Products

The R-S Products Corp. of Philadelphia has announced the promotion of David W. Hopkins to the

position of executive vice president with full administrative authority in the valve, furnace and manufacturing division.

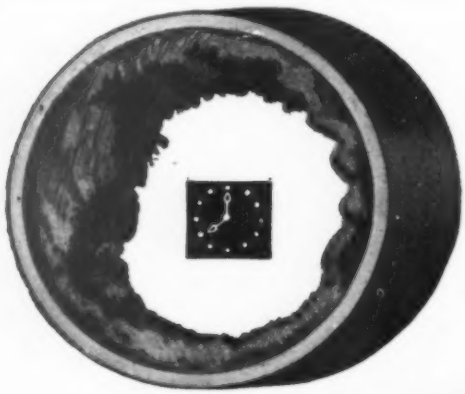
A native of Ohio and a graduate of the Univ. of Pennsylvania, Mr. Hopkins has been with R-S products since 1939 and previous to his promotion was in charge of the valve division.

Westinghouse Welder

A new Flaxarc lightweight engine-driven welder has been designed for 200 amperes at 30 volts on the basis of 50 per cent duty cycle by Westinghouse Electric

Corp., 306 Fourth Ave., Box 1017, Pittsburgh 30, Pa.

Dubbed "The Ranger," this DC welder can be towed anywhere a jeep can take it. It comes complete with accessories ready to weld. The generator is direct-connected to a Hercules IXB engine. The unit is available either as a portable or stationary model.



NATIONAL
KNOW-HOW PAYS

40 YEARS OF EXPERIENCE
FOR A 4 HOUR JOB

A National engineer arrived on the job with his service car at 8 A. M., cleaned 1,800 feet of 10 inch cast iron pipe and returned to his base before noon of the same day. This job, performed for a large industrial plant, illustrates the speed with which pipes can be cleaned by National. Forty years of experience enables the National Water Main Cleaning Co. to clean any water main quickly, with a minimum of interruption to service and a minimum of labor.

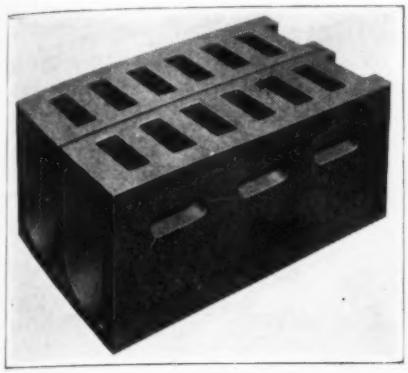
NATIONAL WATER MAIN CLEANING COMPANY
50 CHURCH STREET, NEW YORK 7, N. Y.

ATLANTA.....1221 Mortgage Guarantee Building
BOSTON.....115 Peterboro Street
CHICAGO.....205 West Wacker Drive
HOUSTON.....2518 Grant Street
KANSAS CITY.....421 B.M.A. Building
LOS ANGELES.....448 South Hill Street
MEMPHIS.....822 Dermon Building
OMAHA.....3812 Castellar Street
RICHMOND.....210 East Franklin Street
ST. LOUIS.....7103 Dale Avenue
SALT LAKE CITY....149-151 W. Second South Street
SAN FRANCISCO.....681 Market Street
MONTREAL.....2028 Union Avenue
WACO.....P. O. Box 887
WINNIPEG.....576 Wall Street
HAVANA · MAYAGUEZ, PUERTO RICO · BOGOTA · CARACAS · MEXICO CITY

Filter Underdrain Blocks

Accelo Hi-Cap Filter Underdrain Blocks, designed specifically for prompt removal of sewage as it percolates through a filter, are being offered by Infilco Inc., 325 W. 25th Place, Chicago 16, Ill.

These blocks were developed especially for use in all types of high-rate or high-capacity biological filters. They provide the increased flow and ventilation areas needed



for successful operation of high-rate sewage filters.

These blocks are manufactured for Infilco by the well-known Ayer-McCarel-Reagan Clay Co. of Brazil, Ind. These underdrain blocks are of vitrified, salt-glazed fire clay of great permanency and will not crack or break under the load of the filter media, nor will they clog under long use or deteriorate under the action of sewage. They can be laid directly on the concrete floor of the filter or on a thin layer of grout.

Columbia Chemicals Division News

Announcement has been made by the Columbia Chemicals Division of Pittsburgh Plate Glass Co. that W. I. Galliher has been appointed executive sales manager of both the Columbia Chemicals Division and the Southern Alkali Corp. Mr. Galliher has been associated with Columbia Chemicals since 1931 and since 1943 has been executive sales manager of that division.

Mr. Galliher has announced the appointment of Robert M. Simpson as acting district manager for the Chicago territory of Columbia Chemicals. Mr. Simpson is a native of Little Falls, N. Y., and a graduate of Cornell University. He has been with the company since 1944.

U. S. Pipe and Fdry. Changes

After long service records with the United States Pipe and Foundry Company, three district sales managers retired recently. These were Robert W. Martindale, Pacific Coast Mgr.; William G. Savage, Western Sales Mgr., and Thomas Simons, Southern Sales Mgr.

To replace these men, junior employees were advanced. A. Raymond Hausmann, formerly assistant Pacific coast sales mgr., was advanced to sales mgr. for that territory.

In the Chicago office, Carl N. Brown was advanced from assistant to sales manager of the Western Territory, and J. Leslie Hart becomes asst. western sales manager. In the Birmingham office, Thomas W. McCreery becomes southern sales manager, and Robert C. Lemert becomes his assistant.

FOR SEVERE CORROSIVE CONDITIONS . . .
BITUMASTIC #50 COATS THICK AND TOUGH!
ONE COAT THIS THICK
TWO COATS THIS THICK
THREE COATS THIS THICK

DO YOU WANT IT THICKER?

IF YOU DO, add another coat! There is no limit to the thickness or toughness of the Bitumastic protective sheath you can build up on metal, concrete or masonry where active acids and fumes create a need for unusual measures to combat corrosion.

In spite of its thickness, Bitumastic #50 works easily and is applied readily with a brush. The highly refined coal tar pitch that forms its base is universally accepted as the strongest seal against corrosive action.

There's a data sheet devoted exclusively to the subject of corrosion-proofing for Sewage Disposal Plants—ask for form 342 address Wailes Dove-Hermiston, Westfield, N. J.

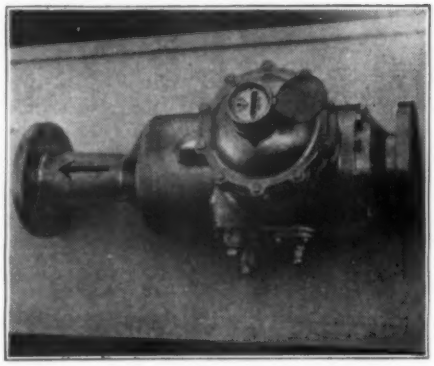
GENUINE
BITUMASTIC
REG. U.S. PAT. OFF.

IS MADE ONLY BY
WAILES DOVE-HERMISTON DEPT.
KOPPERS COMPANY INC.
WESTFIELD, NEW JERSEY

New York 4 • Philadelphia 8 • Cleveland 14 • Chicago 3 • Houston 2
Tulsa 3 • Miami 36 • San Francisco 10 • Los Angeles 1

New Type Compound Meter*

The Challenger Manufacturing Co. of San Jose, Calif., has introduced a new type of meter to the water works field. Neither a copy nor a refinement of any existing type of meter, this new method of metering large flows does so with great accuracy and an unusually low head loss. It is the outgrowth of an hydraulic device developed by the Navy during the war and has been proven by extensive use over a period of three years.



Advantages of this Challenger Fluid Meter include a low head loss of not more than 5 psi. at 700 gpm. for a 4-inch meter; accuracy of registration as low as 1.5 gpm. flow on a 4-inch meter; flow characteristics on proportional type meters; no change-over characteristics of the usual type compound type meter; standard length and flange specifications; self-contained calibration unit; single register, etc.

The new meter complies with the A.W.W.A. specifications for disk, current, and compound type meters for capacity and loss of head tests.

Further information on the Challenger Meter may be obtained from the Challenger Mfg. Co., 41 Wilson Ave., San Jose, Calif.

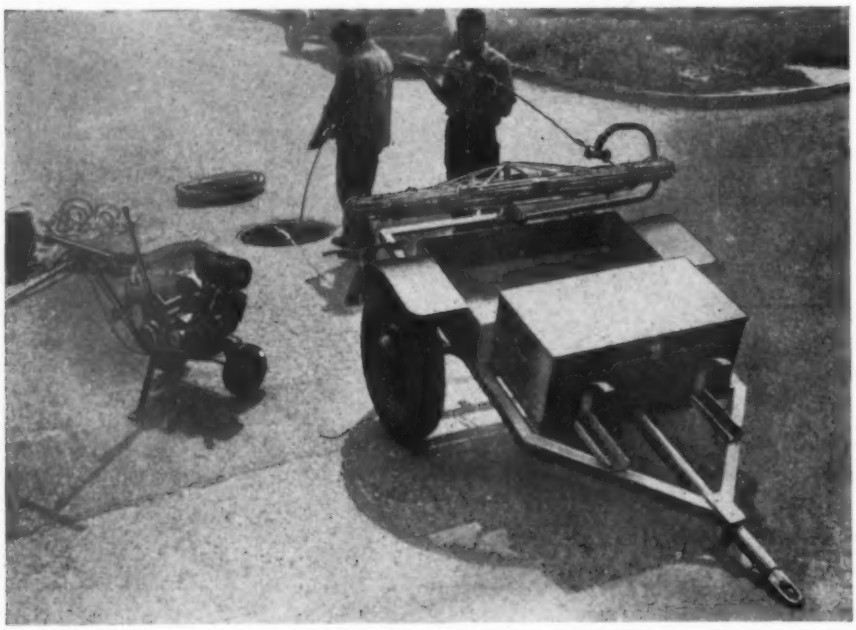
*Through an error this item was published in the July issue without a picture of the meter. We are reprinting the item in this issue with a picture of the meter included.

Packaged Power Take-Off Compressor

Production of a "packaged" Davey Heavy Duty Power Take-Off for Dodge Power Wagon trucks has been announced by the Truck Equipment Division, Davey Compressor Co., Kent, O. Easily installed in the truck's driveshaft, the power take-off immediately converts the Power Wagon into an efficient equipment truck. Truck-mounted equipment is driven direct from the Dodge engine through the take-off. Need for separate, auxiliary engines is eliminated.

Among the ideal Take-Off applications are air compressors, generators, gas well bailers, concrete mixers, farm machinery, fire-fighting equipment, welders, machine shops, pumps, insulation blowers, rock crushers and hammer mills. The Power Wagon Take-Off package, developed in conjunction with the Dodge engineering division, is furnished by Davey complete and ready for easy installation.

Further information may be obtained from the Davey Compressor Co., Kent, Ohio.



YES!

Many of our old customers who saw this new "Carry-All" trailer at the National Federation of Sewage Works Association Convention in San Francisco said emphatically: "YES WE WANT IT!" Initial orders were taken. By the time this ad appears, we will be in production and orders will be filled as received.

If you had seen this complete, compact "Carry-All" you, too would have said "It is a MUST for my department." Always ready to go. Carries entire Flexible rodding outfit.

SPECIFICATIONS:

Two wheel all-steel trailer with adjustable tongue, strong frame and ample reinforcing to last a lifetime; heavy cantilever springs, 5.00x16" pneumatic tires, large tool box with lock clasp, open box for bulky equipment, carrier underneath for 1½" pipe guide, with removable caster wheel for pushing about on the job.

Write today for our New Enlarged 1948 Catalog, just issued

FLEXIBLE SEWER-ROD EQUIPMENT CO.

9059 Venice Blvd., Los Angeles 34, California

855 Board of Trade Bldg. Chicago 4, Ill.
401 Broadway New York 13
147 Hillside Ter. Irvington, N. J.
P. O. Box 165 Atlanta
1624 Harmon Place Minneapolis 3, Minn.
29 Cardan Ave. Roslindale 31, Mass.
P. O. Box 694 Pittsburgh
P. O. Box 447 Lancaster, Texas
41 Greenway St. Hamden, Conn.

Hugh Baker Gen. Sales Mgr. of Mueller

J. W. (Bill) Simpson, vice-pres. in charge of sales of the Mueller Co., has announced the appointment of Hugh L. Baker as general sales manager of the Mueller Co. Mr. Baker has been well known throughout the sanitary engineering field and was promoted from assistant sales manager.

Mr. Baker, a native of Decatur, graduated from the Univ. of Michigan in 1933. He was first employed in the engineering department of the Columbian Iron Works division at Chattanooga in 1934, and later entered the division's sales department, becoming sales manager of that division in 1937. Mr. Baker was transferred to the main office of the company in 1945 as assistant sales manager for the entire Mueller Co.

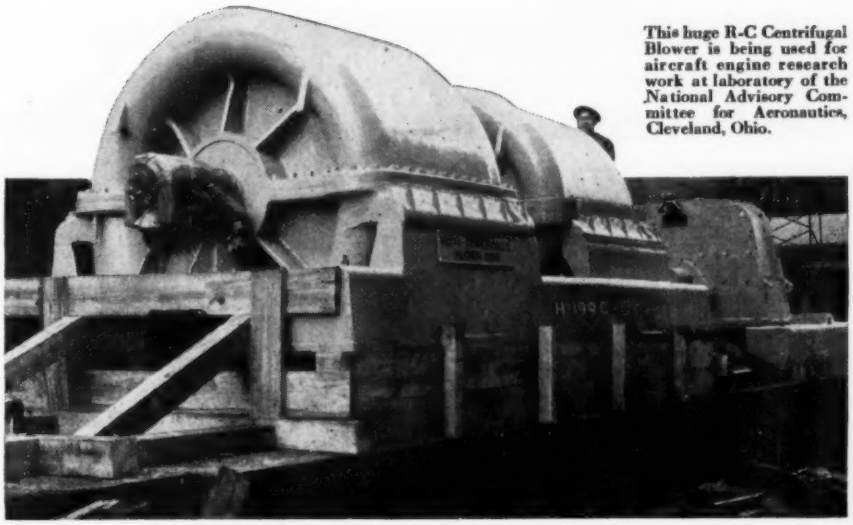
Robert K. Levey, who formerly was a Mueller Co. salesman in the Chicago territory and who has been assistant sales manager of the company with Mr. Baker, will handle promotional and sales personnel work for the company.

Mr. Baker replaces "Bill" Simpson who was advanced to vice-pres. in charge of sales. Mr. Simpson has been with the company since 1899, having served as a messenger boy with Hieronymus Mueller, the founder of the company.

Ives Elected President of Armco

Announcement has been made of the election of S. R. Ives as president of the Armco Drainage and Metal Products Co., Middletown, Ohio. M. C. Patton was elected executive vice president, and H. D. Neill, vice president in charge of sales. Ives joined the company in 1917 as a foreman; he has been vice president and general manager of the company since 1945. Mr. Patton joined the company in 1926, as did Mr. Neill.

Freight car loaded with **WIND**



This huge R-C Centrifugal Blower is being used for aircraft engine research work at laboratory of the National Advisory Committee for Aeronautics, Cleveland, Ohio.

This freight car packs hurricanes! It's loaded with a Roots-Connersville Centrifugal Blower that in just one minute can push the air out of a circular tunnel 10 ft. in diameter and 450 feet long. Or, it can blow a gentle breeze, too, if that's what is wanted.

Your needs may not call for blowers of this size—you may want less or more capacity. Whatever you need, you can get it in Roots-Connersville equipment. And, because we design and build both Centrifugal and Rotary Positive units, we can supply without prejudice the type best suited to your specific requirements. That's R-C *dual-ability*.

Large and small communities have depended for years upon Roots-Connersville Blowers for sewage treatment. That's because they're sturdy and reliable and can be adapted to any modern type of drive.

For long-time satisfactory blower performance, call on R-C *dual-ability*, based on almost a century of blower experience.

ROOTS-CONNERSVILLE BLOWER CORPORATION
709 Mount Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS
★ ★ ONE OF THE DRESSER INDUSTRIES ★ ★

Conventioneers Visit Enterprise Engine Plant

A group of persons attending the concurrent conventions of the A. W. W. A. and F. S. W. A. in San Francisco in July visited the Enterprise Engine Co. plant in San Francisco. The group, shown in the accompanying picture, inspected plant facilities, watched operations, and heard R. H. Hundley, Chief Engineer of the Enterprise Diesel Div., describe the operation of the dual fuel diesel engine which will operate on either oil or sewage gas with a small amount of fuel oil for pilot ignition.

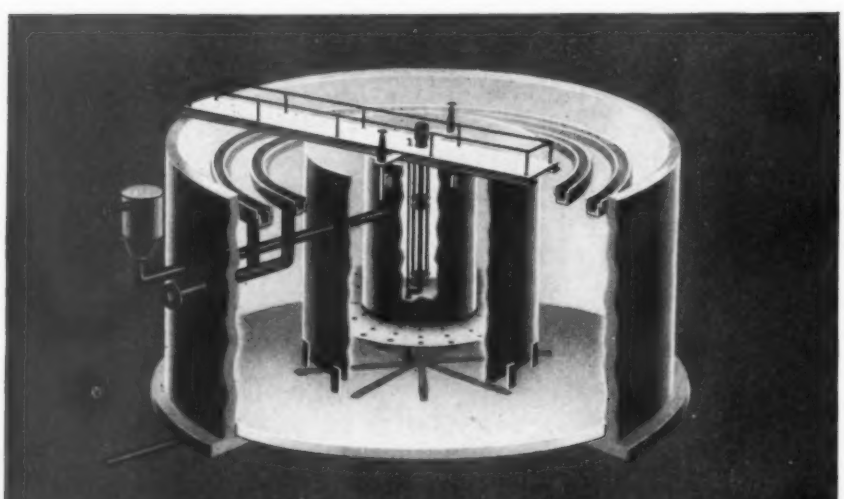
FOR WATER SOFTENING . . . TURBIDITY AND COLOR REMOVAL
. . . INDUSTRIAL WASTE TREATMENT . . .

The Clariflow

with independently-operated mixing, flocculation, stilling and sedimentation zones

A notable improvement over conventional short-retention water treatment units. Provides individual functioning of mixing, flocculation, stilling and sedimentation zones. • Its control over short-circuiting, control over each function and control of sedimentation through low weir rates mean improved effluent . . . higher filtration rates . . . longer filter runs . . . better industrial waste recovery and treatment.

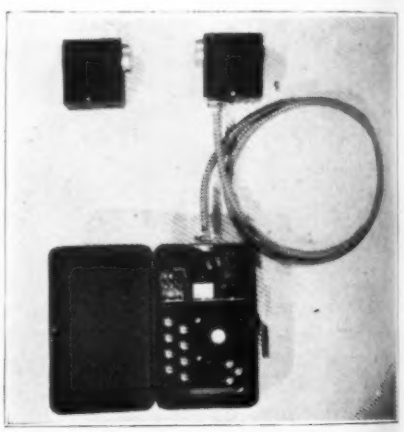
Write for Bulletin 6S6



WALKER PROCESS EQUIPMENT INC.
YEARS OF EXPERIENCE TOGETHER IN EQUIPMENT ENGINEERING
AURORA • ILLINOIS

New Photoelectric Control Equipment

Photoswitch Incorporated has introduced Photoelectric Control Type 20DJ1. This is a high-speed, rugged, general-purpose control specifically designed for industrial application. It is recommended for counting, conveyor control, automatic paint spraying, break detection,



automatic weighing, sorting, gate signals, as well as automatic control for hundreds of industrial processes.

The phototube and light source lamp are in small dust-tight, die-cast housings, both wired to the control housing. A temper-proof sensitivity adjustment is provided on the control housing to permit positive operation over varying distances from control to light source and under conditions of ambient light.

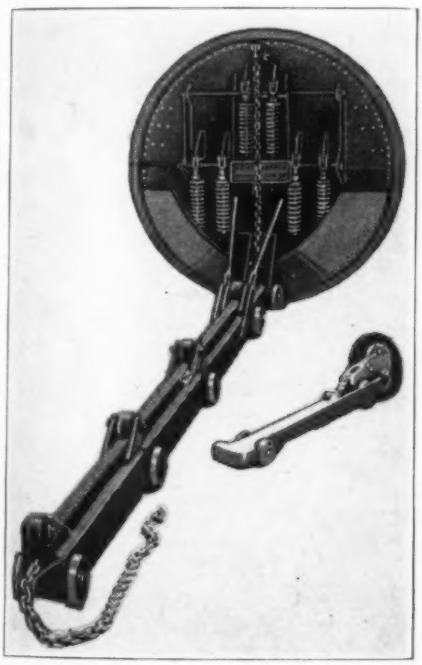
For further information write for Bulletin No. PA 477. Address your request to Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass.

Wailes Dove-Hermiston Now Division of Koppers

Wailes Dove-Hermiston, which was purchased in December, 1945, by the Koppers Co., Inc., has ceased to operate as a separate corporation and is now known as the Wailes Dove-Hermiston Dept. of Koppers Co. In this new organizational change the Wailes Dove-Hermiston Dept. will take over all of the protective coatings formerly produced by Koppers and will continue manufacture of its present products. Linden Stuart heads the new department and William Thornill will continue in charge of sales. No changes in personnel, products, or service are contemplated.

World's Largest Sewer Cleaner

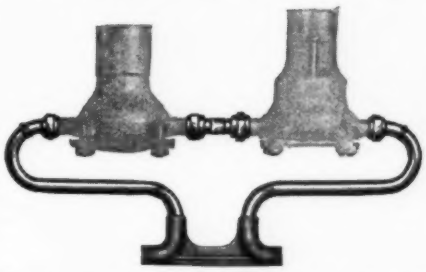
J. C. Fitzgerald of Coral Gables, Fla., manufacturer of the Sewer Scooter, and hydraulic self-propelling sewer cleaning equipment, has



made an eight foot Scooter for cleaning large size sewers. Shown in the accompanying photograph is the new cleaner alongside the smallest one made, an 8-in. model.

This large model will not be sold but will be used on contract for cleaning storm drains and interceptors. In the New England district, including the Pennsylvania, New York, and New Jersey as well as the New England states, contract cleaning work will be carried on by the M. W. Bailey Co. of Brooklyn which will represent Mr. Fitzgerald.

AIDS IN MODERN METERING



The TANDEM RESETTER permits connecting two domestic meters in series without piping changes. These useful fittings are made in three types, for basement and outside meter settings.

To compare the performance of two meters in actual service, or to convince a skeptical customer that his meter is not too fast, it is frequently desirable to connect two meters in series. The simplest way to do this is to connect the bar of a TANDEM RESETTER into the position ordinarily occupied by the meter and then connect the meters into it.

Ford Meter Idlers are ideal to connect in place of meters when they are removed. They are all brass, with accurate threads, full gasket faces and wrench flats.

Meter Idlers are made in four sizes, for ⅝ , ⅝×¾", ¾" and 1" meters.

Meter adapters screw onto meters to build them out to the same thread size and length of larger meters so that they can be easily installed where larger meters have been. Many services are over-metered, and Meter Adapters on smaller meters offer a real economy in meters as well as better registration of the smaller flows.

* * *

Our catalog tells all about these Aids in Modern Metering. Your copy sent for the asking.

The FORD METER BOX COMPANY, INC., WABASH, INDIANA

Fluidyne Centrifugal Pump

The Peerless Pump Div. of Food Machinery Corp., 301 West Ave., 26, Los Angeles 31, Calif., has introduced a new single stage, end suction centrifugal pump with vertically split case centrifugal pump. Known as the Fluidyne, it is designed to fulfill a need for an economical general utility centrifugal pump with power drives from fractional to 20 H.P.

The Peerless Fluidyne is manufactured in two types, both of which are capable to moving water or other liquids in capacities up to 1000 gpm. against heads up to 270 ft. One type is integrally coupled with an electric motor, and the other is a belt-driven unit. The Fluidyne may be installed to operate in any position, vertical, horizontal, or intermediate angle.

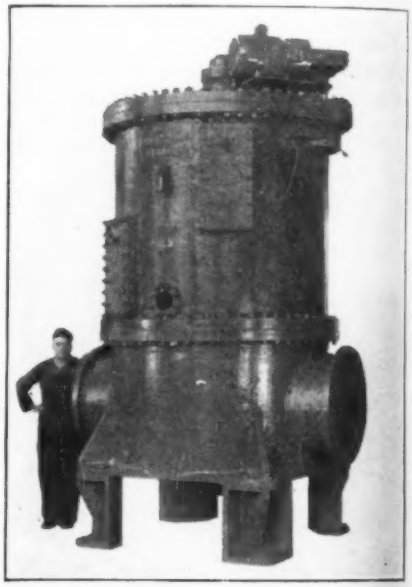
J. C. Kennedy Dies

Vice Pres. of Kennedy Valve

J. Carroll Kennedy, vice president of the Kennedy Valve Mfg. Co. of Elmira, N. Y., died late in June following an operation. Born in Brooklyn in 1877 and one of the sons of the founder of the Kennedy Valve Mfg. Co., Mr. Kennedy had been vice president of the company in charge of manufacturing for 20 years.

Self-Cleaning Water Strainer

A practical and proven type of strainer is finding a broad application in the treatment of certain types of water supplies, particularly when the load from suspended matter is heavy. This strainer, manufactured by S. P. Kinney Engineers, Inc., Pittsburgh, Penna., is known as the Brassert Self-Cleaning Water Strainer and consists essentially of a slowly revolving conical drum, which is retained in a heavy housing. The drum may be equipped with numerous types of removable straining media (porcelain strainers, stainless steel screens or bronze slotted cones). These strainers have been found to give excellent service in the removal of sand from well water. An article on this use at Houston, Texas, appeared in this magazine some years ago.



According to the size of the strainer, the housing is equipped with one or two backwash ports. As each of the removable straining media pass by the backwash ports, automatic washing of the strainer takes place.

These strainers are built in sizes ranging from 3 in. pipe size to 30 in. pipe size; each strainer is equipped with a gearhead motor requiring ½ to 5 HP. for operation.

Further information on these automatic strainers may be obtained by writing the S. P. Kinney Engrs., Inc., Pittsburgh, Penna.

10 minutes

...and this one-man repair is completed

Repair broken water lines easily, quickly, without shutting down. Dresser Style 82 Repair Sleeve is installed in 5 to 10 minutes by one man using only a wrench. Adjustable to exact fit—even on off-size pipe—by means of interchangeable sections. A permanent repair *at low cost.* Specially compounded rubber gaskets provide flexibility, help prevent future breaks. For CIP from 4″ to 8″ in diameter.

"ADJUSTABLE" REPAIR SLEEVE STYLE 82

The modern, quick, low-cost repair sleeve.

DRESSER STYLE 82 REPAIR SLEEVES

ONE OF THE DRESSER INDUSTRIES

Dresser Manufacturing Division, Bradford, Pa. • 1121 Rothwell St., Houston, Tex.
In Canada: Dresser Manufacturing Co., Ltd., 60 Front St., West, Toronto, Ont.

The SEWER SCOOTER

(U. S. Patent 2,198,823)

THE ONLY 100% SELF-PROPELLING SEWER CLEANER

SEWER SCOOTER MODEL A-3, BRONZE

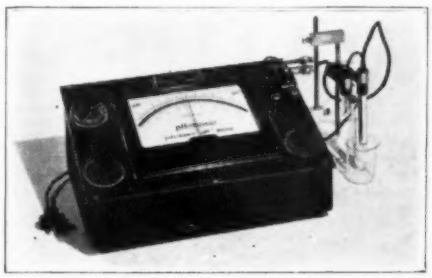
Standard machines stocked 8 inches to 8 feet—For sale, rent or contract.

J. C. FITZGERALD

Box 289-A
Coral Gables 34, Fla.

Line-Operated Electronic pH Meter

Photovolt Corp., 95 Madison Ave., New York 16, N. Y., has announced a new electronic pH meter. This new Photovolt pH meter combines the high accuracy of a laboratory-type instrument with the ruggedness and simplicity of operation of an industrial model. It has a large indicating meter equipped with a seven in. scale and a mirror for convenient reading and high precision. The meter covers the complete pH range and is always ready for immediate readings. No batteries are employed. The instrument operates directly by any AC power line of 50-60 cycle frequency.



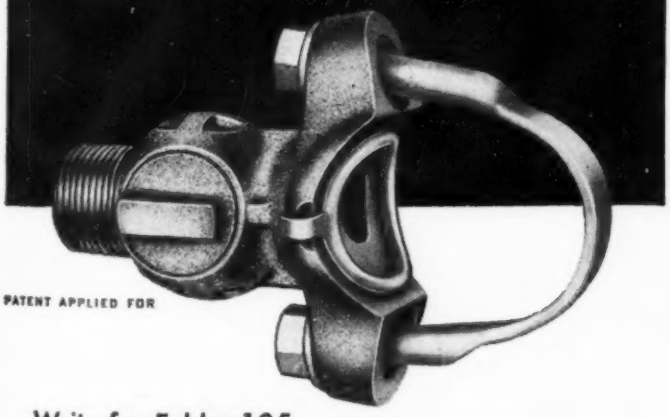
This instrument, shown in the illustration, is designed for laboratory and industrial application, for all types and designs of electrodes, for pH, titration, and oxidation-reduction potentials.

This new electronic pH meter is also available with an electrostatically shielded compartment and a wooden hood with carrying handle, in which form it is a completely enclosed compact unit which can be easily carried and stored.

It's New . . .

HAYS "DUO-STOP"

A Combination Corporation Stop and Saddle That's Simpler to Apply, Stronger in Service



PATENT APPLIED FOR

Write for Folder 105

HAYS COPPER · BRASS · LEAD · IRON WATER WORKS PRODUCTS
HAYS MANUFACTURING CO., ERIE, PA.

NINE IMPORTANT ADVANTAGES of the New HAYS "DUO-STOP" and Pipe Saddle

- The new Hays "Duo-Stop" makes possible a quick, simple, and safe installation of corporation stops on small mains of 2" size, where the small diameter and the thin wall make it impractical to tap the main.
- The "Duo-Stop" is strapped securely and permanently to the main, the stop is opened, and the hole is drilled, by a drilling machine inserting the drill through the stop.
- The installation may be made while the main is under water pressure - - Thus no shutdown of service.
- There is no threaded connection in the Pipe Saddle Shut-Off; stop and service clamp are one piece, solid rust-proof bronze, pressure tight and leakless.
- The extra strength, secured by one-piece construction and reinforced ribbed design, prevents distortion due to strain of strapping, or of outside stresses, and assures perfect functioning.
- The lead gasket provides a tolerance that guarantees a tight fit on either cast iron or steel service mains.
- The 2" "Duo-Stop" Saddle is designed for use on either 2" cast iron or steel pipe. The 2¼" "Duo-Stop" Saddle is designed for use on either 2¼" cast iron or 2½" steel pipe.
- The fact that service clamp and stop are cast in one piece simplifies purchasing and stock-keeping. Eliminates necessity of purchasing as separate items.
- Outlets for all types of services.

Bailey Meter Assigns Field Engineers

H. M. Hammond, Vice Pres., Bailey Meter Co., has announced that the last members of the 1946-47 Cadet Engineering Class have been assigned to the company's branch offices. J. H. Wilson reported to the Cincinnati office in August and R. W. May will report to the New York office in September. Both men are graduate mechanical engineers, Wilson from Purdue and May from Clarkson.

Another training course started July 18 with fifteen graduate engineers and one engineering student attending.

Pittsburgh Imo Meter Introduces New Model

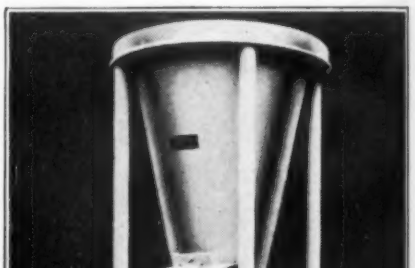
The Pittsburgh Equitable Div. of the Rockwell Manufacturing Co. has announced that volume production has again been attained in the manufacture of the well-known Pittsburgh Imo meter. This meter had been shelved during the war because of inability to obtain necessary materials.

A new Type 2 Imo meter, now being made, is superior to the Type 1 model produced before the war. It has a larger measuring chamber to provide increased capacity and rotors of larger diameter to provide greater driving power at slower operating speeds. This Imo meter is manufactured under license from Aktiebolaget Imo-Industrie of Sweden. It is a rotary screw propulsion type.

Further information may be obtained from the Pittsburgh Equitable Meter Division, Rockwell Manufacturing Co., Pittsburgh 8, Pa.

Permutit's New Dry Chemical Feeder

Exhibited for the first time at the annual conference of the American Water Works Association in San Francisco was the new Permutit displacement type dry chemical feeder. Having extreme accuracy over a wide range, the feeding mechanism is entirely enclosed, although inspection can be made through a transparent door. The new unit is adaptable to either acid or alkaline chemicals and either constant or proportional feeding may be used.



Accuracy of the feeder at low feeding ranges makes it practical for small water treatment plants. When small rates of chemical feeding are desired, one hopper full of chemical

Hazleton Type "M"

CHECK VALVE

with Built-in Mercoid Motor Shut-off Switch for Automatic Pump Protection

PROTECTS PUMP FROM DAMAGE DUE TO LOSS OF WATER

PREVENTS OPERATION OF PUMP UNTIL PROPERLY PRIMED

Flow switch insures pump against damage in event pump loses water during operation. Mercoid switch is actuated by valve-flap. Switch is connected into no-voltage coil of motor starter.

Write for Further Information.

BARRETT, HAENTJENS & CO.

HAZLETON PENNSYLVANIA

will allow the feeder to operate for several days unattended.

Further information and literature may be obtained from the Permutit Company, 330 W. 42nd St., New York 18, N. Y.

New Home Garbage Grinder

A new garbage grinder or automatic home pulverizer for the kitchen sink is now available. Known as the Waste King Pulverator, the

unit is simple to operate, odorless, clog-proof, economical and completely safe to use. Food wastes are put down the drain opening, the Drain-Control Top is turned to the "ON" position and the water is turned on. Within a matter of seconds, bones, parings and fiberous foods are ground into minute particles and the water swirls them away in a scouring action.

The unit is easily installed in any sink with a drain opening of 3½ to 4 inches in diameter. Only one electrical outlet is required for electrical connection, and the Waste King does not require external switches or supporting brackets. Another feature is the patented, triple cutting and shredding action allowing food wastes to flow down the drain in one operation. Costing only a few cents per month to operate, the Waste King Pulverator has a capacity of three quarts at one time, more than ample for the average family.

Further information may be obtained from the Given Mfg. Co., 3855 Santa Fe Ave., Los Angeles 11, Calif.

Rustrem Now Available in Aluminum

Speco, Inc., Cleveland, has announced that Rustrem (Rust Remedy) anti-rust paint is now available in aluminum as well as in black. This new paint can be applied right over rust without brushing or scraping. It is reputed to immediately penetrate the rust layer, render it inactive and seal the surface against further rusting.

Other features claimed are high resistance to chemical action and immunity to climatic changes.

It is especially recommended for use under water, in salt water, or in locations where dampness and moisture are ever present. Rustrem Aluminum can be painted over with any high quality paint or enamel.

Among the most commonly listed applications in water and sewage works are the following: metal poles, manhole covers, pipe, gratings, hydrants, etc.

For further information write Speco, Inc., 3142 Superior Ave., Cleveland, Ohio.

There's just one way a Mathews Hydrant is like an ordinary hydrant—it can be knocked out in a traffic mishap. But the makers have a quick and perfect answer to that problem—a removable barrel containing all the working parts.

This barrel is to a Mathews what a spare tire is to a car. Two men with a lug wrench can unscrew the barrel and insert another in no time. An above-ground job, it does away with pavement-breaking and excavating. Usually before its service is missed, the hydrant is back on duty—cost and precious time held to the minimum. And, thanks to this exclusive Mathews feature, repairs can be done in the shop.

Mathews Hydrants are known and preferred the world over. Choose Mathews for your community and you'll be rendering a public service of the highest order.

OTHER FEATURES OF MATHEWS LEADERSHIP

Head can be rotated a full circle, on swivel flange • Replaceable head permits change in nozzle outlets • Nozzle levels can be raised or lowered without excavating • Barrel screws into bronze bushing in elbow • Operating thread (easily accessible) is only part that needs oiling • A modern barrel makes even the oldest Mathews good as new.

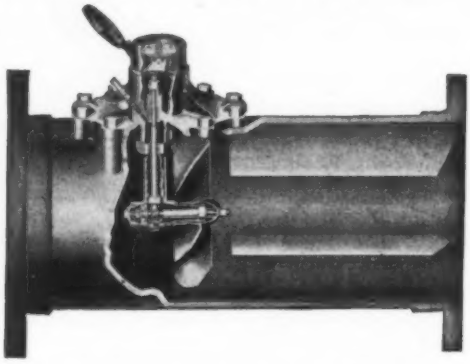
MATHEWS HYDRANTS

Made by **R. D. WOOD COMPANY**

PUBLIC LEDGER BUILDING, INDEPENDENCE SQUARE, PHILADELPHIA 5, PA.

Manufacturers of "Sand-Spun" Pipe (Centrifugally Cast in Sand Molds) and R. D. Wood Gate Valves

SPARLING MAIN-LINE METERS



for SERVICE and SATISFACTION

Bulletin 309 comes upon your request.

FOR over 27 years the Sparling Meter has been giving thoroughly satisfactory service measuring flows—from pumps; into reservoirs, distribution lines and so on. Note the Direct Action—a propeller revolving with the flow is geared to a register reading in the desired unit! Each meter is a complete Totalizing unit, with Indicator, Recorder or Controls added as needed!

J. W. SPARLING *Manufacturer of* WATER MEASURING EQUIPMENT

LOS ANGELES 54...Box 3277 Terminal Annex
CHICAGO 16.....3104 South Michigan Ave.
622 Broadway.....CINCINNATI 2
101 Park Avenue.....NEW YORK 17
BOSTON 8.....6 Beacon Street

84" pipe—Spring Lake, N. J.

FLANGED PIPE

FLEXIBLE JOINT PIPE

BELL & SPIGOT PIPE

SPECIAL CASTINGS

SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

Warren Foundry & Pipe Corp.

11 Broadway, New York

Warren Pipe Company of Mass., Inc.

Parkhurst Heads Lee Hydraulic

Ray Parkhurst, formerly vice-pres., sales mgr., and director of the Rensselaer Valve Co., Troy. N. Y., has resigned this position to take over the management of the Lee Hydraulic Co. also of Troy.

Lee Hydraulic Co. produces Duro valve and service boxes and the Bardwell pipe wrench.

Dorr Decorates Westport Mill With Mural

Conceived in the mind of John V. N. Dorr as a means of decorating the stucco panel of the wall of the Westport Mill of The Dorr Co., and at the same time presenting the subject matter relative to The Dorr Co. history and operation throughout the world, a completed mural was unveiled to the public in mid July.

Artistic license was granted to balance the design in the available area and this resulted in a switch of continents, placing the America's in the center, flanked by Asia on the left and Europe on the right. Furthermore, no attempt was made to depict the history and development of the company in too literal a fashion. Consequently, though the subject matter is all relative to company history and development, it does not attempt to cover all phases or even the major phases of its past and present operation.

The mural does depict the classifier, agitator, counter current decantation side by side with sketches of the original processing methods they replaced. There are such diverse subjects as the original Westport Mill, the Black Hills of South Dakota, a scene of Mr. Dorr's original inventions, and the desilting plant for the All American Canal. These are intermingled with figures symbolizing various phases of engineering, personalities within the company and an occasional touch of whimsey such as the Dodo Bird.

The artist was Eric Stocklassa, well known Swedish artist. The mill, of course, does not carry on studies in the field of water and sewage treatment, but the company has a high interest in these two fields.

LITERATURE AND CATALOGS

"Tips" on Good Sewer Construction

Myron T. Jones, Consulting Engineer of Columbus, Ohio, developed a highly useful and instructive set of "Standard Instructions to Sewer Inspectors." So clear cut and useful have these instructions proved to be in the construction of sewers and drainage lines that the Clay Sewer Pipe Association of Columbus, Ohio, has by authorization reproduced these "Tips on Good Sewer Construction" for general distribution.

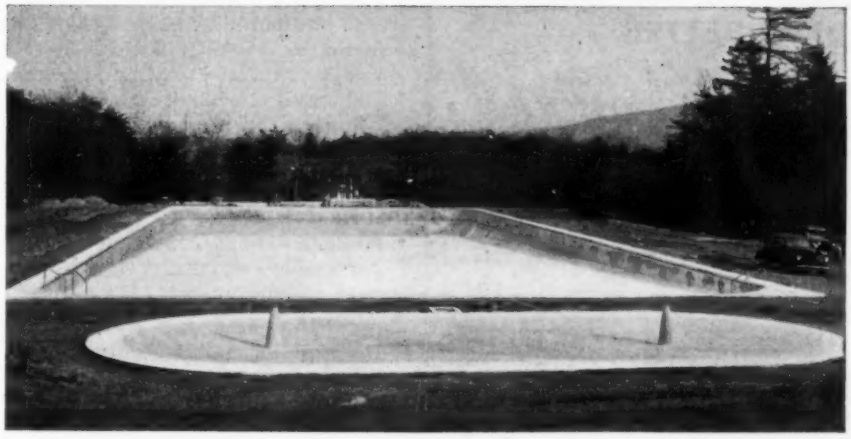
The instructions give the step by step procedure of the sewer construction crew and the engineer's inspector charged with seeing that the construction is properly done. These instructions given in their logical sequence, are prepared for cutting into sheets of a size for the inspector's note book.

As many copies of these prepared "Instructions to Sewer Inspectors" as may be desired can be had by engineers or others who request copies from the Clay Sewer Pipe Ass'n, 1105 Huntington Bank Bldg., Columbus, Ohio.

"Compressed Air Handbook"

"Compressed Air Handbook," first edition, published by Compressed Air and Gas Institute, New York, N. Y., 400 pages, 6x9 inches, 247 illustrations, including photos and drawings; stiff-backed, simulated leather cover, gold embossed; price, postpaid, anywhere in United States, $3.00 per copy; elsewhere $3.50.

"Compressed Air Handbook" is published to meet widespread demands for a reference text on applications, installation, operation and maintenance of compressing equipment and air-powered tools of all types. In addition to making available a mass of new and original data not heretofore published in a single volume, the Handbook contains, in revised and improved form, all of the standard reference material formerly published as "Trade Standards." Included are definitions, test standards



"GUNITE" SWIMMING POOL

The 90' x 225' all "GUNITE" swimming pool and wading pool pictured above is at Palmerton, Penna. This municipal pool was built by us last fall in accordance with our design and is similar to many others we have designed and built in the past.

"GUNITE" is adaptable for several types of private and public pools and offers advantages of complete watertightness, freedom from maintenance expense and low initial cost.

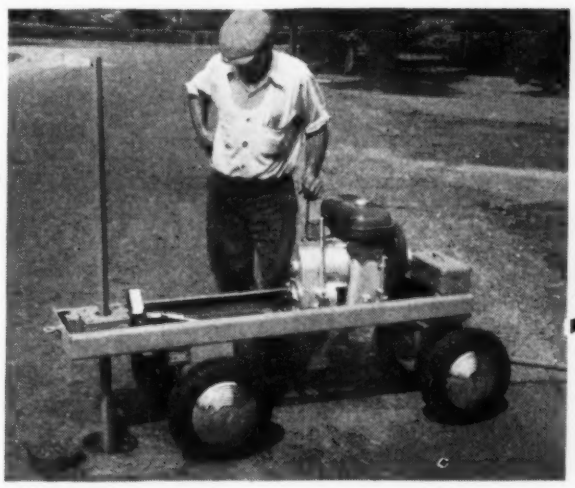
If you plan to build a swimming pool we will be pleased to submit designs and estimates.

Our 72-page bulletin C2300 illustrates pool construction and scores of other uses of "GUNITE." Write for your free copy.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.

PAYNE DEAN GATE OPERATOR

NEW! NEW!



SOMETHING NEW FOR QUICK OPERATION OF GATES TO 30 IN. A PORTABLE GAS ENGINE DRIVEN GATE OPERATOR-UNLOAD IT AT THE JOB AND LET THE TRUCK GO ABOUT ITS REGULAR BUSINESS. ONE MAN CAN HANDLE THE LITTLE FELLOW. 6 H.P. MOTOR. HUSKY, STRONG (450 LBS.) BIG TIRES AND BALL BEARING WHEELS FOR ROUGH GROUND. SAFETY SHEAR COUPLING-REVOLUTION COUNTER AND REVERSE GEAR. SPEED RANGE 15 TO 30 TURNS A MINUTE.

PAYNE DEAN & CO., MADISON, CONN.

FOR BETTER
pH Control
and WATER TESTS
there is nothing like

NON-FADING
GLASS COLOR
STANDARDS

Pocket
Comparator
No. 605

Permanent reliability of Hellige Glass Color Standards, accuracy of color comparison, simplicity of the technique, and compactness of the apparatus are exclusive features of Hellige Comparators not found in any similar outfits.

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and numerous basic tables and formulae.

The object in producing "Compressed Air Handbook" was to provide a comprehensive volume of reference data which would meet technical and engineering needs and, at the same time, serve the layman and student with information on the wide versatility, flexibility and utility of modern compressed air power.

"Compressed Air Handbook" represents the collective knowledge, experience and thought of the 19 member companies of the Compressed Air and Gas Institute, and was compiled over a two-year period as a joint undertaking of the Institute's educational and technical committee.

Dresser Industries

In a beautifully illustrated and printed catalog of 112 pages, Dresser Industries, Inc. have told "how Dresser Industries helped convert natural resources to the service of man." The book is titled **Dresser Industries, Inc. "All Along the Line,"** and it tells who makes up the corporation, what the individual companies make, and how the whole organization operates. A map shows the location of the plants of the 14 member companies and a tipped-in diagram shows a panoramic view of the many applications of the Dresser Industries products.

The book itself is devoted to pictures of the products of the various companies associated with Dresser Industries. Those of particular interest to the water and sewage works field are the Bryant Heater Co.; Clark Bros. Co., Inc., manufacturers of compressors and diesel engines; Dresser Mfg. Div., makers of steel coupling sleeves, repair sleeves, fittings, etc.; Pacific Pumps, Inc., manufacturers of cen-

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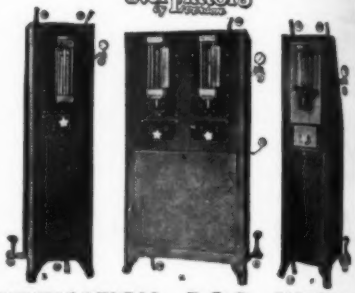

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trifugal pumps and vertical turbine pumps; Roots-Connersville Blower Corp., manufacturers of positive displacements, centrifugal blowers and exhausters, as well as oil and gas meters; and Stacey Bros. Gas Construction Co., makers of gas holders.

Water Main Cleaning

Under the intriguing title of **Let's Look Into This Matter of Water Main Cleaning,** the National Water Main Cleaning Co., 50 Church St., N. Y., has issued a bulletin showing pipe lines before and after cleaning. Photographs of actual operations are shown and discussions are given on such items as the causes of clogged mains, means of recognizing the need for main cleaning, and the method by which it accomplishes the main cleaning.

The bulletin closes with a few typical results in various cities showing the diameter of the pipe, the length cleaned, the discharge before and after cleaning, and the frictional loss before and after cleaning, together with the increase in carrying capacity after cleaning.

Cement Lining of Mains

Centriline Corp., 140 Cedar St., New York 6, N. Y., has issued a bulletin under the title **The Centriline Process—Centrifugally Applied Cement Mortar Lining for Water Mains.**

The 30-page bulletin contains a discussion of the development of water main reconditioning and the effectiveness of cement linings, diagrams showing the head loss of lined vs. unlined pipe, tables of coefficients before and after lining in various cities, pictures of the Centriline centrifugal lining machine, its different sizes, pictures of the machine in operation, and pipe requiring lining.

Also presented is a discussion of the high rate of capacity loss for unlined pipe. Physical tests of the cement mortar lining, flexibility, and sealing effect are also discussed.

One section of the bulletin is devoted to typical specifications and another to a listing of contracts completed, and still another to unsolicited letters of commendation.

Persons interested in improving the carrying capacity of large water mains should write for this bulletin on the Centriline Process.

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For exact chemical feeding install OMEGA Gravimetric Feeders! They continuously weigh any dry material on sensitive scales and deliver exactly the amount per hour required, in accordance with the rate preset — over a 100 to 1 range. OMEGA Dust Removers are available to insure dust-free operation: dusty air is drawn through filter bags and the collected dust falls into the feed hopper — without waste. Automatic proportioning controls and alarm devices can also be furnished.

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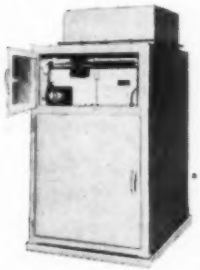

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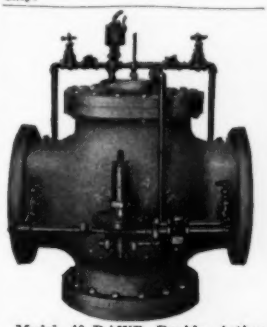
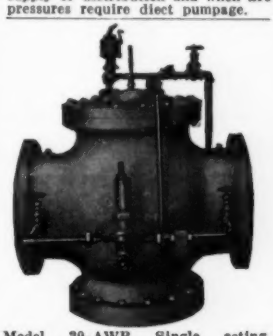
Altitude Valves for tank and reservoir, with two sets of controls—Automatic Hydraulic and Electric Remote Control. Hydraulic pilot normally operates the valve, while electric pilot is used for emergency only.



Model 40-DAWR Double Acting may be operated by electric pilot regardless of elevation of water in tank or reservoir, for a break in supply or distribution and when fire pressures require diect pumpage.



Model 30-AWR Single acting valve may be contolled in same manner as the Model 40-DAWR.

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Pipe Lining

The Preload Corp., 420 Lexington Ave., New York 17, N. Y., has a pipe lining bulletin in which is described **Automatic Preload Pipe Lining.** Pictures are shown of the old way of manually applied standard gunite and the modern way in which the lining is mechanically applied by the automatic Preload lining and troweling machine.

The bulletin contains a discussion of the history of pipe lining and of the economics of pipe lining. Graphs are included to show the loss of head for unlined pipe as against lined pipe.

The bulletin also contains a section on operation of the pipe lining machine and the advantages of the Preload method. The automatic operation is applicable to pipes of 30 in. and greater in diameter.

The bulletin includes a return card which may be used to obtain further information from the company.

Sewer Cleaning Equipment

In Catalog 8A, titled **Complete Sewer Cleaning Equipment,** the Turbine Sewer Machine Co., 5210 W. State St., Milwaukee, Wis., presents its complete line of products.

Included in the catalog are the power sewer cleaning units, adjustable sewer cleaners, stoppage drags, geared hand windlass, bucket system, cable guide, sewer cleaning cables, special sewer rods, root harpoons, clothes, self-propelling turbines, and the like.

The bulletin also contains a section on the Sewer Master, a small electric sewer and pipe cleaning machine for cleaning roots and sewers of small size.

There is also an operating manual showing the turbine system of sewer cleaning by diagram and direction.

Catalog 8A is available on request.

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Crackless Concrete Construction

Crackless Concrete Construction is the title of a bulletin issued by The Preload Company, designers and constructors of a system of reinforced concrete construction whereby steel bands are tensioned around a concrete shell.

The bulletin shows several installations of Preload concrete water tanks, including various designs, and dome covers for water tanks. The method of construction is described in the bulletin.

Laboratory Guide

The Pennsylvania Sewage Works Assoc. still has a number of copies of the **Laboratory Guide** which was issued after the lecture laboratory course on sewage treatment held in Philadelphia, Pa., at St. Joseph's College in the spring of 1945.

Edited by D. Paul Rogers, Principal Chemist, Bureau of Engineering, Penn. Dept. of Health, the book is a very handy guide book for sewage treatment plant operators and chemists. The book is confined primarily to such determinations as were presented at the short course. It does not cover all of the tests which can be made. The attempt has been made to arrange the material so that the guide may be of practical use to operating personnel and all sewage plants regardless of size or type. The book defines each test, indicates its purpose or use in the control of sewage works operation, gives step by step directions of procedure, and interprets the results by means of examples and notes.

Pictures of laboratory equipment are shown, tables of handy data are given, and a list of chemicals and equipment necessary for small laboratories is also presented.

Persons desiring a copy of this book should write to Bernard S. Bush, Secy., Pennsylvania Sewage Works Assoc., State Dept. of Health, Wilkes-Barre, Pa.

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TABLE OF COMPARATIVE QUANTITIES

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6	2.5	3.00	2.25	11.71
8	2.5	4.00	2.25	14.63
10	2.5	5.00	2.25	17.70
12	2.5	6.00	2.25	20.86
14	2.5	7.00	2.25	24.02
16	2.5	8.25	2.25	33.07
18	2.5	9.25	2.25	36.88
20	2.5	10.50	2.25	40.71
24	2.5	13.00	2.50	53.02
30	2.75	16.00	2.50	65.36
36	2.75	19.00	2.50	77.96
48	3.50	30.00	3.00	121.15
54	4.0	38.00	3.00	135.60
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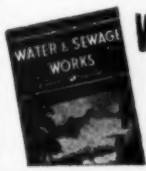

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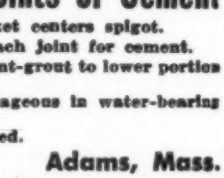
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In a four-page folder that opens to present testimonial letters, Tate Pipe Linings, Inc., 47 Haverhill St., Andover, Mass., has presented a description of **The Cleaning and Cement Lining of Existing Pipelines in Position by the Tate Process.**

The folder shows the operating principle of the Tate lining process, how the cleaning operations are carried out, and how the cement mixture is prepared and applied to the pipe in position.

The Tate process is advertised as "the cure and prevention of corrosion in pipe lines by Tate Process—used the world over."

Further information is available on request.

Rust Preventative

If you haven't seen the bulletin on No-Ox-Id vs. Water, issued by the Dearborn Chemical Co., 310 S. Michigan Ave., Chicago 4, Ill., you may be interested in the **Dearborn Products for Water and Sewage Works.**

The bulletin contains the story of No-Ox-Id and the prevention of rust, a list of applications for the various types of No-Ox-Id, and the use of No-Ox-Idized reinforced fabric wrappers.

Illustrations of typical applications and uses of this effective coating are shown throughout the book.

Lectures on Sewage Treatment

The Pennsylvania Sewage Works Assoc., of which Bernard S. Bush is secretary and J. R. Hoffert editor, has issued the series of lectures which were given at the St. Joseph's College in Philadelphia in 1945.

This lecture-laboratory course was conducted under the auspices

of the Penn. Sewage Works Assoc. and the faculty of St. Joseph's College in Philadelphia, with Francis S. Friel as director and chairman of the program committee.

The staff for this series of lectures consisted of a number of outstanding men in the field of water and sewage treatment. These lectures were later printed in *Sewage Works Journal* and the Penn. Sewage Works Assoc. has had them reprinted in one booklet.

As a series of fundamental discussions and presentations of the problem of sewage treatment, this series of lectures cannot be excelled. Copies of the reprint may be obtained from Mr. Bush.

Electric Equipment for Sewage Works

The General Electric Co. of Schenectady, N. Y. presents their **Complete Coordinated Electric Equipment for Sewage Treatment Plants** in Bulletin GEA-4732.

In a series of double page spreads, the application of G-E equipment is shown for pumping, sedimentation, aeration, sludge digestion, sludge gas utilization, sludge dewatering, sludge drying and fertilizer production, and sludge incineration. There is electric equipment for operation and control of every process from raw sewage to treated effluent.

This bulletin is available on request.

Water Service Products

In folder 104 the Hays Mfg. Co., Erie, Pa., shows its **Water Service Products** including corporation and curb stops, couplings, fittings, branch connections, and lead goosenecks.

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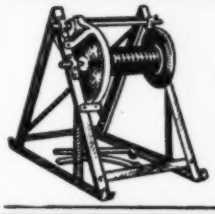

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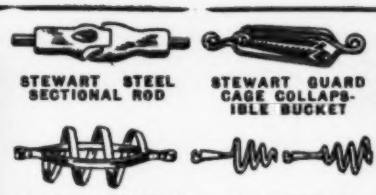

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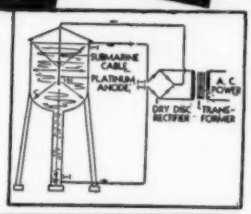

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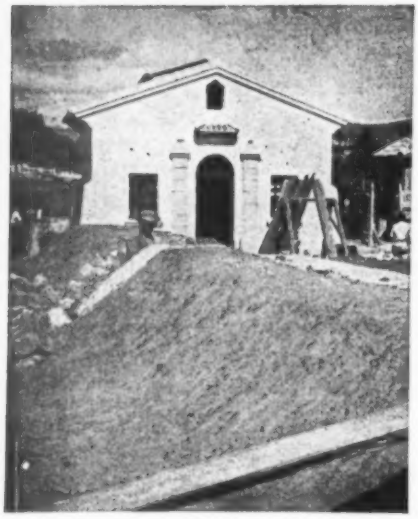

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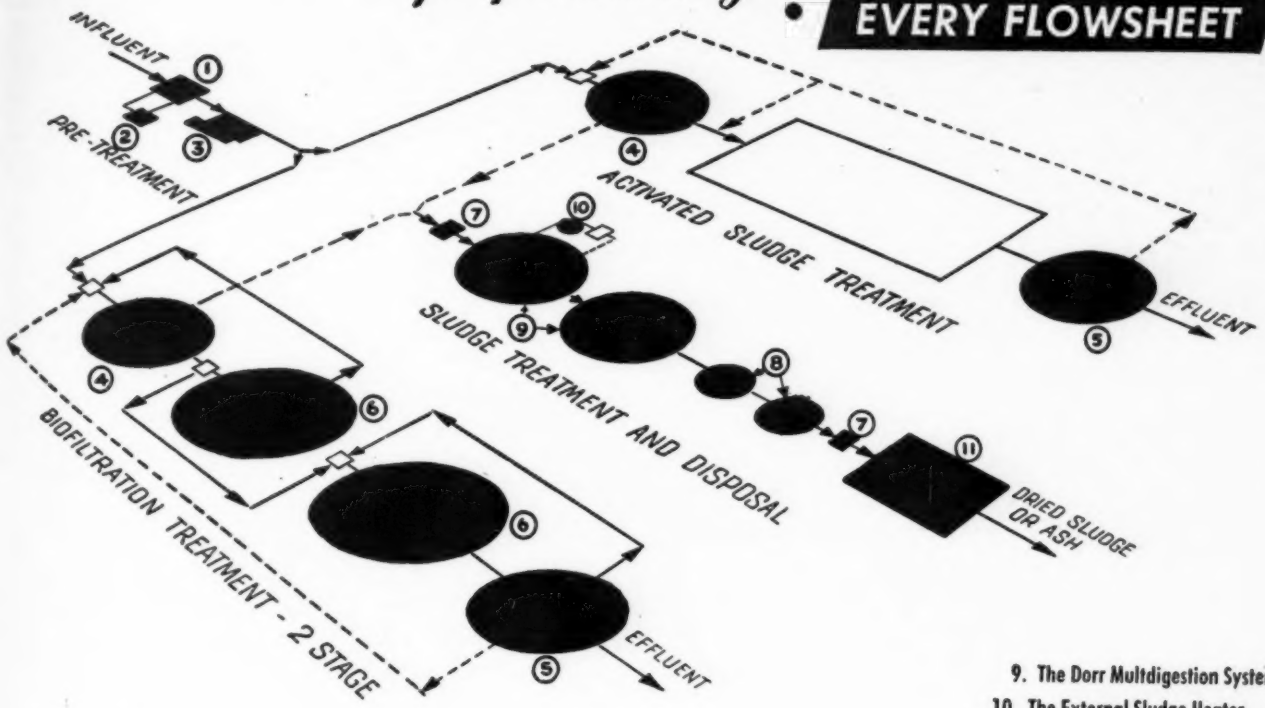

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